THE MODEL ENGINEER

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THE
MODEL ENGINEER

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SMOKE RINGS

Our Cover Picture

CONCENTRATION—that is the key-note of our cover picture this week. It is concentration on the joy of driving a miniature steam locomotive, a joy which is experienced by hundreds of THE MODEL ENGINEER readers. Mr. Leonard Taylor, of the "Bryn" Garden Portishead Railway, kindly sent us the photograph, and our artist, Mr. Mudge-Marriott, has transformed it into one of his clever line drawings. The locomotive driver is Mr. Frank Owner, Chief Engineer of the Bristol Aeroplane Company, who finds this model experience a change from jet engines.

He Likes His Job

HERE is a little human touch from a reader who is foreman engineer in a large factory in Liverpool, and an enthusiastic model engineer in his spare time. He writes: "There cannot be many people who can truthfully say that the more they see of their job the better they like it, but, strange though it seems, I am one." He is not alone in the world, for I am of the same way of thinking myself. It is a great thing to be able to go to your bench or your desk each morning and say to yourself, "Here's a job worth doing, let us get on with it."

CONTENTS

Vol. 96 No. 2383
JANUARY 9th, 1947

My Greeting Cards

MY cordial thanks to all those readers at home and overseas who have helped to decorate my office and my home with charming cards of friendly greetings and good wishes for Christmas and the New Year. They are too numerous to acknowledge individually, but I feel I must quote one greeting on a card from Mr. and Mrs. Simpson, of Brentwood, the hospitable founders of that popular pre-war model engineering outing known as "Simpson's Day." The message reads: "At Christmas we light the Candles of Happy Memories, and one of them is for you." Truly a delightful thought.

Photographing Models

THERE are many reasons why models are photographed. It may be as a personal record of a piece of work well done, it may be for a club album, for a trade catalogue, or to accompany an article for THE MODEL ENGINEER. But it frequently happens that the photograph fails to do justice to the model. Leaving aside the limitations imposed by your equipment or photographic inexperience, there are many defects which can be remedied by a little extra care and thought when taking the picture. How many photographs are spoiled, for example, by an unsuitable background. Pictures taken in the

garden often include such unsightly settings as a trellis fence, a mass of foliage, or a wrinkled blanket or sheet of paper behind the model. The angle at which a locomotive or ship model is taken is often quite unnatural. We do not usually look at a real locomotive from a view-point above the boiler, yet many models are photographed downwards instead of from a horizontal, or even a rail level point of view, as we so often see the prototype in real life. The effective lighting of a model is another secret of a successful picture. One of our constant editorial problems is to try to produce a good illustration from an amateur photograph containing some of these defects. A good model is worthy of a good photograph, and to try to raise the pictorial standard of model records, we have recently published a very practical handbook on the subject, entitled *Photographing Models*, price 3s. This book has been written by Mr. John H. Ahern, who is well known in the model railway world, not only by his beautiful scale modelling of railway subjects, but equally so by his excellent photographs of his own miniature work. As a Fellow of the Royal Photographic Society, he is an acknowledged expert, and his book will be found to contain a host of practical suggestions which will do much to enhance the future records of model engineering in photographic form, and will, we hope, have a beneficial influence on the pictures submitted by our readers for editorial inspection.

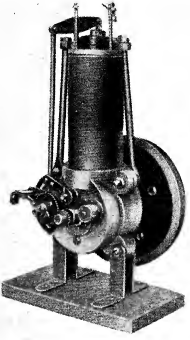
The New England Live Steamers

ONE of the most attractive greeting cards which arrived in my Christmas mail came from Mr. Lester D. Friend, of 90, High Street, Danvers, Mass., the President of the New England Live Steamers Inc., that most enthusiastic brotherhood of lovers of the locomotive in miniature. The card bears photographs of several of the prominent members of the movement, with their engines, the star picture showing a beautiful ¾-in. scale "Mikado" type locomotive, built by Mr. Malcolm Spangenberg. Our old friend, Mr. John D. Matthews, of Chicago, is represented by a steam tractor and a simple oscillating cylinder locomotive bearing the magic name of "Curly." At the meeting of the Live Steamers held in October last, no less than 300 members registered, representing 28 States in the U.S.A., and including 14 members from the Live Steamers of Montreal, in Canada. Fifty-one different engines were under steam, and 23 chassis were on display in the adjacent Yankee shop. For 1947 six further meetings are planned, and I think this is an appropriate moment to extend hearty good wishes from all Live Steamers at home to their brethren across the Atlantic. May fine weather and good running attend all their gatherings.

The Magic of Cable and Wireless

I RECENTLY paid a visit to a remarkable magician's parlour in the heart of the City of London. This was the telegraph station of Cable and Wireless Ltd., at Electra House, on the Embankment, the largest telegraph station in the world. At the invitation of the Manager, in the person of Col. H. J. Wellingham, an old friend of THE MODEL ENGINEER, I was shown how messages from and to all parts of the world are received and dispatched in the twinkling of an eye. At least so it seemed to me as I watched the progress of some of the hundreds of cable forms which are delivered, sorted, directed and speeded on their way every minute of the day and night. An average of 50,000 messages are dealt with every twenty-four hours. Transmission overseas is either by submarine cable or by beam wireless, as conditions at the moment may determine, and it is amazing to think that messages from Australia or New Zealand can reach London in a few seconds, and can be delivered to their final destination in a matter of minutes. At Electra House, every possible time-saving device is in operation. If a few seconds can be saved by using a band conveyor, a delivery shoot, or a revolving card index, there it is, while the alertness of the large expert staff in handling the messages themselves is remarkable. Even the world-wide transmission of photographs is now an every-hour event, and I was shown some results in which the perfection of the picture as received was hardly distinguishable from that of the original. Engineering plays a notable part in this magician's work, and I was interested to peep into the mechanics' shop where the delicate telegraph instruments are kept in prime condition, and where much valuable experimental work is done. In the basement the Company has its own emergency power plant consisting of two fine sets of Davey Paxman's engines, most ingeniously mounted on anti-vibration bases to avoid disturbing tremors in the building. The engine room was kept as spotless as the lounge of a luxury hotel. Of course, I looked for a model somewhere in the building, and found one in the entrance hall—a large model of the world on which the routes of various messages were indicated by coloured lights when the appropriate key button was pressed. I first met Col Wellingham many years ago when I visited the training school in North London, where, under his supervision, cable operators received excellent workshop tuition to enable them to maintain their instruments in good working condition in whatever out-of-the-way cable station they might be located. Since those days he has seen many parts of the world, his unique telegraphic and engineering experience being most valuable in the R.E.M.E., in which distinguished service he held high rank during World War number two. He is an ardent motorist and drove a much treasured old-timer among cars in the recent annual run of "old crocks" to Brighton. He is truly in his element as chief magician in that wonderful organisation at Electra House.

Percival Marshall



The Story of a Petrol Engine

by J.L.

AT the present time I am in the process of setting up my workshop anew after a period of immobilisation due to the war, and while looking over the pile of junk assembled on the floor of the new shop, awaiting the inevitable sorting out, my eye alighted on the old petrol engine that drove my lathe for nearly twenty years, and is now due for retirement in favour of an electric motor.

The sight of this old stalwart brought back a flood of recollections extending down the years to my boyhood days, when I first made the acquaintance of THE MODEL ENGINEER; and before it went into honourable retirement, it seemed to me that its history might be of some interest to our readers.

Since its construction in 1912, it has been chopped and changed about to such an extent at various times that nothing now remains of the original design except the bore and stroke, and even these measurements have been altered slightly.

Crude and unreliable to begin with, when made by a schoolboy's impatient hands, it gradually reflected the increasing knowledge of the advancing years, until in its final form it became "Old Faithful," driving the shop so well for many a long evening that there never seemed any need to turn it out in favour of electric drive.

Naturally, she is no beauty; the many alterations and additions have made it impossible for her to have the trim appearance of an engine designed as a whole; but the essentials are there, and she has fulfilled her purpose, so one need not be too critical of mere looks.

The story begins in those far away days before World War I, when I was a schoolboy, with all a schoolboy's enthusiasm for amateur mechanics and the usual lack of cash and facilities to assist in gratifying these instincts.

At that period, mainly owing to lack of tools, my model-making activities were mostly confined to model aeroplanes, and electrical work such as small induction coils, battery lighting sets and the like, and my reading matter, in addition to THE MODEL ENGINEER and its handbooks, consisted largely of the well-illustrated catalogues of the Economic Electric Co., of Twickenham, and similar firms. Needless to say, most of my pocket money went in their direction also.

I had a great desire to own a dynamo to replace my bichromate batteries and accumulators, most of which were almost always in a state of chronic discharge; and therefore my joy was unbounded

when I was given a real dynamo as a Christmas present.

Although it is unfortunately no longer in my possession, I remember the details of it perfectly. It was a 30-watt Avery-Lahmeyer type machine with an 8-cogged drum armature. The ironwork was painted in holly green and, with its taped and yellow varnished field coils, it had an attractive appearance. It came from Gamages, and was undoubtedly good value at 30s.

I soon fixed it up on a board, with a wheel and hand crank to drive it, and had the satisfaction of getting about 10 watts out of it by arm power alone.

However, this exercise soon palled, and I began to seek for some easier way of getting that 10 volts 3 amperes of which it was said to be capable.

My first idea was to use my bicycle ; the back tyre was removed, and the machine suspended by ropes from the roof of an outhouse, so that the back wheel was just clear of the ground. Further cordage stayed the outfit sideways to hold it steady enough to allow a cord belt from the rear wheel to drive the dynamo when I mounted and pedalled.

With this arrangement I was able to get the full 30 watts, and I even remember making an attempt at accumulator charging.

Naturally, this could not be a permanent arrangement, and it was obvious that an engine of some sort was the proper solution, but having no lathe at that time, making one seemed out of the question.

A 6-ft. wooden windmill was tried, and also a water motor, but there was never enough wind for the mill when I wanted it, and all sizes of jet and ratios of gearing on the water motor failed to produce more than a few watts, so the problem was shelved for the time being.

A little later I built my first lathe, a small and crude affair of $1\frac{1}{2}$ in. centre height, and having a 1-in. diameter round bar as a bed.

The water motor served to drive it *via* a string belt and a perambulator wheel on the tail-end of the mandrel. In spite of its shortcomings, it turned out what seemed to me at the time to be excellent work ; and so my thoughts now returned to the possibility of making an engine to drive the dynamo and I searched the pages of THE MODEL ENGINEER for a suitable design.

I thought I could manage some sort of a steam engine, but a boiler to produce steam for $\frac{1}{8}$ h.p. was beyond my skill.

All the gas and petrol engine castings on the market were far too large and heavy for my lathe, even if obtained in the part-machined condition; also the price was beyond me.

Things were at this stage about the beginning of 1912, when an article appeared in THE MODEL ENGINEER of January 25th which excited my interest and finally my enthusiasm.

"A Small Petrol Engine," by J.W.T., described a 2-in. × 2-in. vertical four-stroke of simple design which was built as an aero engine, and considering the date it was made and the purpose he had in view, it would be hard to beat for simplicity of construction. The illustration of the engine at the head of this article is reproduced from THE MODEL ENGINEER.

I have often wondered at the identity concealed under the initials "J.W.T." and whether he and his engine are still with us ; if so, I would like to meet him and thank him for the inspiration afforded by his excellent article of thirty-four years ago.

For the benefit of those readers who have no access to these early issues of THE MODEL ENGINEER, a short description of his engine may be of interest.

Simplicity was the keynote, and the use of easily available material. The cylinder was a piece of 2-in. bore weldless steel tubing bored smooth internally for the piston, which was made from a W.I. tube plugging cap, the piston rings being turned from the excess material at the mouth of the cap.

The cylinder-head was a flat steel plate held down by a cross bar and two tension rods to the crankcase, valve seatings being machined in the plate with a ring of holes round the guide to pass the gas.

Of course, no silencer was possible without considerable extra complication, but, naturally, was not required for an aero engine, and was in any case considered by me at that period to be an unnecessary refinement.

The carburettor was a simple suction valve type without float or throttle, built up from brass tube and sheet material, and held down to the cylinder head over the automatic inlet valve by a couple of screws.

The circular aluminium crankcase was split in the vertical plane in the usual way and held together by four bolts. The castings for both halves were identical, so that one pattern served for both.

A fixed stud supported the timing gear, which was fully exposed. A push-rod and overhead rocker operated the exhaust valve.

The ignition gear was the wipe contact-maker common at that period.

As the exhaust valve was $\frac{15}{16}$ in. diameter and the inlet valve $\frac{13}{16}$ in., naturally there was not a great deal of room for the sparking plug in the cylinder-head, after space had been found for the rocker support, cross bar, carburettor, etc.

At that date small plugs were almost unknown ; the full-sized 18-mm. was the recognised standard, and it was impossible to find space for it in the head, so a porcelain plug centre only was fitted, held in position by a little triangular clamp and three screws, which was a very sound arrangement to get over the difficulty.

No cooling of any sort was provided, but the designer suggested that a water jacket might be fitted to the cylinder if the engine were used for stationary work.

He prefaced his description with the remark that the engine had considerable power and speed.

The design looked good to me, and with the exception of the crankcase, I thought I saw my way to make it all on my small lathe.

An ambitious programme, no doubt, but I was urged on by the exciting possibilities that would reward its successful completion. From much reading on the subject, I knew that a 2-in. × 2-in. cylinder should be good for $\frac{1}{4}$ h.p. at least, and so I felt confident that, even making considerable allowance for bad workmanship, I ought to be able to get out of it the 1/10 h.p. required to drive the dynamo.

As will be related in due course, I did not copy the published design faithfully in all respects, but made several departures from it, in some cases to make a fancied improvement, but mostly to facilitate construction with my limited equipment.

It would have been much better, as it turned out, to have stuck closely to the original, as most of the troubles subsequently encountered might have been avoided.

A start was made by getting the necessary material together. The steel tube for the cylinder and a couple of suitable brass gears for the timing were obtained from Cotton & Johnstone, of Soho. Bright mild steel, both round and flat, for various details, came from George Adams, whose large and excellent catalogue was a well-thumbed volume of my library.

I also bought a miniature sparking plug, screwed $\frac{1}{8}$ in. gas, from Gamages, and thought I was very fortunate in being able to fit a proper removable plug instead of having a makeshift.

It was an unfortunate choice; the plug was a dud, and was the cause of a lot of subsequent grief, which I did not anticipate at the time.

The material for the head stumped me for a bit. I required a disc of steel about $2\frac{3}{8}$ in. diameter $\times$ $\frac{1}{4}$ in. thick. No doubt this was not a very formidable requirement if I had had a little more knowledge of where to go for it, but at the time I relied on George Adams or the local ironmonger, and for this particular item they failed me.

Finally I discovered a piece of suitable (or perhaps I should say very *unsuitable*) material in the form of a small and very rusty railway fish-plate; it was much thicker than I needed, which I judged would not be detrimental, but I saw that I could cut a $2\frac{3}{8}$-in. diameter disc from it with a hacksaw.

In those days I was not nearly so frightened of hacksawing large pieces of steel as I am now; although my saw had only a 6-in. blade, which was never discarded until most of the teeth had disappeared. Even so, I still remember that particular job, and the hours of labour that elapsed before I finally hacked it out. All the corners had to be sawn off and the whole edge smoothed up with a file before it would swing in the lathe for facing and turning the cylinder register.

My only chuck was a 2-in. lever scroll, which just held it at the maximum capacity of the jaws.

At this stage, a description of the lathe may be of interest, as showing what sort of a tool I had to work with.

I still have the headstock casting (it was later converted into an emery grinder), but the rest of it, I am sorry to say, disappeared long ago, being used as required for material for later projects, without thought of any sentimental value it might have in later years.

Fig. 1 shows a rough outline of the tool as I remember it. Fig. 2 is a photograph of the headstock.

The main inspiration of the design was the famous £5 round bed Drummond, then just newly on the market; but just why I decided on such a small centre height as $1\frac{1}{2}$ in. I can't remember; probably I considered it enough for my requirements at the time.

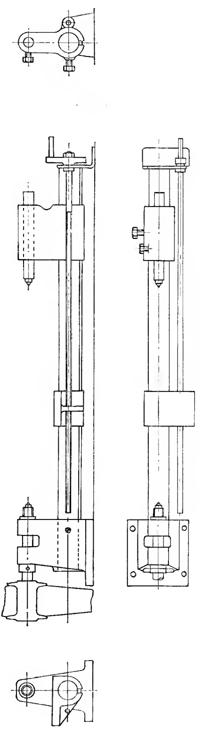


Fig. 1 The $1\frac{1}{2}$-in. centre lathe

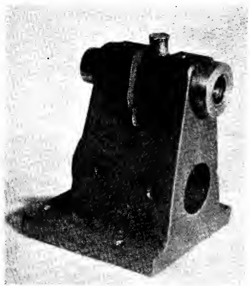


Fig. 2. Headstock of $1\frac{1}{2}$-in. centre lathe. Bush and lubricator were fitted at a later date when it was used as an emery grinder

As will be seen, a 1-in. diameter bright steel bar formed the bed, and guidance for the saddle and tailstock was provided by a length of $\frac{1}{4}$-in. or $\frac{3}{16}$-in. square drawn brass rod screwed down to a flat carefully filed the full length of the bed.

The saddle traversed along the bed with the aid of a lead screw, made from $\frac{1}{4}$-in. diameter B.M.S., screwed full length with a $\frac{1}{4}$-in. Whitworth die.

The web of the saddle was tapped to take the screw. It was intended to fit up change-wheels for screwcutting, but this never materialised, and all threads on the engine were cut with taps and dies.

A cross-slide for the saddle, made from bright drawn mild steel section was designed, or, shall I say, schemed out, but did not turn out a success; so all facing was done with the flat of a hand graver, and infeed of the tool when required in normal turning was achieved by loosening the tool clamps slightly and tapping in the tool carefully with a hammer.

The degree of accuracy in parallel turning was not great, and did not even pass my very tolerant inspection; so saddle feed was only used for roughing down, and careful filing and calipering relied on to bring pins and shafts to a reasonable state of truth.

The tailstock had a sliding barrel, held by a set-screw, but no screw feed was provided, although it was intended to fit it later; however, this was never done, as I discovered that I could drill quite satisfactorily by towing the tailstock along with a bar from the saddle.

The machining on the main castings was done for me, but was not an expensive matter, as it consisted only of drilling a 1-in. and a $\frac{1}{2}$-in. hole in both headstock and tailstock to take the bed and spindles.

The drive was from the water motor previously mentioned, *via* a round belt to a good-sized pram wheel on the tail of the mandrel, which overhung the end of the bench on which the whole contraption was mounted.

A second and smaller pram wheel was also available, to give a faster speed, but was not often in use, owing to lack of sufficient power from the water motor.

For heavy jobs, in lieu of a back gear, manual aid was given by an assistant, who helped on the flagging motor by inserting a stick in the spokes of the pram wheel and winding vigorously.

A 3-in. faceplate, made from a small backplate casting, and the scroll chuck mentioned, comprised the equipment.

Looking back on it now, I am surprised that I did not devote some of my surplus energy to building a better tool, but no doubt I was largely ignorant of where to obtain proper material, and in any case, I was in a hurry to get on.

The cylinder head was the first item to be tackled, and it did not take long to face it up on both sides and turn the register, but owing to the limited centre height it could not be swung on the faceplate to machine the valve seatings.

So two pieces of tool steel were forged out flat, to make a sort of piloted counterbore, and with this held in the chuck, and the pilot fitting the previously drilled hole for the valve stem, a pair of fairly good seatings were recessed out.

Valves and rocker gear presented no particular difficulty, except a lot of tiresome roughing out from solid stock, and the next job was the boring of the cylinder.

I had a vague idea at the start that I would be able to bolt this to the saddle in some way, and bore it out with a bar between centres in the usual manner, but after looking at it a while, it became obvious that this method was not going to answer with such a small lathe.

I therefore schemed out the rig shown in Fig. 3, and with this arrangement the bore was finally completed more or less to my satisfaction.

The lathe, in its original state, was not long enough to take the necessary boring-bar, but this was easily remedied by buying a 2-ft. length of 1-in. B.M.S. from Adams. The old bed became the boring bar.

As the cut could not start at the extreme end of the cylinder owing to the endplates it had to begin about $\frac{1}{2}$ in., and the tube was left over length, so that the unbored piece could be cut off afterwards.

The tube had two holes drilled near one end, one to allow a screwdriver to be inserted to tighten the grub screw holding the cutter and the other to form a place for the tip of the cutter to start in.

The trueing-up of the tube on the bar, and the setting of the cutter, was a very tricky business, as can be imagined. Two cuts were taken down the bore, just enough to clean it up. The result, on inspection, showed a very poor finish indeed.

I remember having the feeling at the time that the bore looked much better before it was machined than it did afterwards, but a bit of lapping with a wooden lap took away the worst of the marks, and I hoped that the running-in process would remove the rest.

(To be continued)

"Helen Long" Attains Her Majority

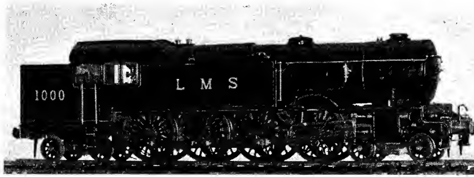
By "L.B.S.C."

THE locomotive forming the subject of this week's illustration is of more than passing interest in many ways, and maybe a few words about her will be of interest to many new readers of these notes, especially those who are inferior in years, to the lady in question. "Helen Long" was not only a unique type at the time she was built, but represented the successful achievement of the desire of her present owner, to see one of his "creations of the drawing-board" actually brought to life, and able to perform in the manner usually observed among the "pedigree" locomotive fraternity. She is also a very striking illustration of the old saying about "great minds thinking alike," for the whole of the L.M.S. characteristics she possesses, were drawn out by Mr. Josslin long before they were ever produced at Derby or Crewe. In fact, if Sir W. A. Stanier had designed a 4-8-4 tank engine for the L.M.S., the odds are a million dollars to what "Itma" calls a "sninch of puff," that it would have practically been a 4-ft. 8½-in. gauge edition of "Helen," differing only in unimportant details.

Mr. Josslin is a draughtsman by profession, mostly engaged on structural engineering, but has always been very keen on locomotive designing, and soon after the end of the first period of mass insanity on this unlucky planet, he produced a series of designs for what I nicknamed the "Josslin heavyweights." These were locomotives far larger and heavier, in proportion to size, than anything ever placed on the railways of this country; and in passing, I helped a friend who is a driver on the G.W.R., to play a practical joke on the drivers and firemen at several sheds on that line. One of the designs represented a huge 4-8-2 of ultra-Bill-Massive proportions, drawn with all the Great Western characteristics, so we got a blueprint and faked it up with the Swindon wording and numbering, making it look very "official," and my friend showed it "in strict confidence" to sundry fellow-conspirators at various sheds, as an example of what was cooking up on the quiet in the Swindon locomotive factory, saying that it was intended to settle the "most powerful locomotive" argument for good and all time in favour of the G.W.R., and it was intended to haul a 20-coach train from Paddington to Bristol at an average of 80 m.p.h. start to stop. Two firemen would be needed on each engine, taking turns to feed the huge firebox. Incidentally there's many a true word spoken in jest; from what I hear, the Southern "biscuit-boxes" could often do with two firemen! However, the reactions were very amusing, and there was great consternation among the G.W.R. enginemen until the legpull was disclosed.

"Hope Deferred Maketh the Heart Sick"

Mr. Josslin never had a workshop of his own, having always lived in "digs," and for some time he tried to get various parts of his locomotives made by both professionals and amateurs, but being what he terms a "bit fussy," could get nothing done to his liking, and told me many tales of money wasted on leaky boilers, and components of inferior workmanship. He even went to the extreme of hiring a so-called mechanic and paying him an hourly rate, to make parts of a locomotive to specification, but got no satisfaction. He then got into communication with a British designer, well known at that time, and commissioned him to get some parts made; but that worthy "had ideas of his own" that didn't agree with Mr. Josslin's, especially as regards bore and stroke of cylinders, valve gears and setting, and other vital points. In consequence, Mr. Josslin was loaded up with some "standard" stuff that was useless for the erection of any of his locomotive designs, and began to despair of ever seeing one "in the flesh."



The original "Helen Long"

A Ray of Hope

Just about this time our worthy friend had occasion to visit England, and it so happened that the visit coincided with the flare-up we had in the correspondence columns of this journal, known as the "Battle of the Boilers," in which your humble servant, who had been experimenting quietly for years and had found out a dickens of a lot, took the weights off the safety-valves and started blowing the "laws of the Medes and Persians" sky-high. Mr. Josslin read the correspondence, got into communication with me *via* the Editor, and told me all his troubles; the upshot was, that he eventually came along to my old home at Norbury, brought his drawings, and we had a jolly good pow-wow over them. He said he had been told that they were all impracticable by people who reckoned to know all about it. I didn't agree at all, and said that in the light of what I had found out by experimenting, they should all prove good engines if placed on the track. It was then that he told me of all his unfortunate experiences, and asked if I could help him in any way to achieve his ambition of owning a successful locomotive of his own design. I said yes; if he picked out his favourite, I might be able to supply the essentials, as I couldn't build the complete engine by the time Mr. Josslin was due to return to Canada.

The Birth of "Helen Long"

The engine selected by our friend from his batch of drawings was a 4-8-4 tank; he called her a "Dominion" type, by way of coining a type-name, as there were no standard-gauge tank engines at the time, having that wheel arrangement, as far as we knew. However, enginemen are renowned for finding nicknames for everything, and I called her "Helen Long" for the simple reason that she was just that! The full-sized blue-print of the engine was the longest one I had ever seen. When I asked Mr. Josslin about the detail drawings and inside motion, he frankly confessed that there weren't any, saying that what concerned him most, was the outline and superstructure. He had drawn in what he considered to be a suitable arrangement of cylinders and motion, "to make up the picture," in a manner of speaking; and if I would undertake the making of the engine or parts thereof, I had a free hand to alter the "works" to suit my own ideas, as long as I kept to his general outline. This suited me fine, so I agreed to do as much as I possibly could, by the date of his departure for Canada, so that he could take something back with him. He said he would like the boiler, as that could easily be fitted to the chassis in Toronto; and if I could make any fittings as well, so much the better. I said O.K., and he took his departure from Norbury with delighted anticipation, leaving behind a yard or so of blueprint.

I studied the picture, took outside dimensions of the boiler and smokebox shown, and schemed out a suitable inside firebox and arrangement of tubes. "Operation Kettle" was then put into action; and ere long, the boiler was ready for a steam test. Friend Josslin was duly notified, and came along and saw the test. I then asked him about his ideas of backhead fittings, and he gave me an outline of what he would like, one item being a battery of screw-down valves at one side of the backhead, connected to a single manifold fitting, and provided with unions for coupling up to various accessories be had in mind. I carried out all his specifications as near as was consistent with good working qualities. He admitted to being very fussy over details; I certainly found him so, as I had four shots at getting the contour of the chimney exactly to his liking! However, his honest appreciation of my efforts to make amends for all his previous disappointments and disillusionments, was well worth the trouble; I never grudged a moment of the time spent in trying to please "Bro. Alex!" By the time he was due to set sail for Canada again, I had completed the boiler with all fittings and mountings, including dump grate and ashpan, smokebox and chimney, and a few odd accessories for the engine; and when he took them away, he said it was the first time in all his experience that he had got exactly what he wanted.

The Chassis Follows On

The next job was to scheme out a suitable arrangement of cylinders and motion, to conform to the "picture," and yet give satisfactory operating results. This wasn't a difficult job at all; I just called my "visualising" gift into action, and soon had a mental photograph of what was needed. Mr. Josslin specified cast-iron cylinders; I didn't approve of this, knowing what goes on inside small cylinders when they are left idle for any length of time, but he said he would take all precautions to prevent any deterioration, and would accept responsibility. No castings were, of course, available, so I had to set to work and make special patterns for both the cylinders and the driving wheels, which also were not a stock size at that date. Stuart Turner's did the castings, and a jolly fine job they turned out; everything flawless, and very nice metal to machine up. I got two sets of cylinders, in case of any mishap in machining, or hidden flaw in the castings, but neither trouble eventuated. The second set of outside cylinders were finished off for a personal friend; the spare inside cylinder casting I still have here now. I was only looking at it a couple of days ago, time of writing, as I hope to build another single-cylinder toy locomotive for a young friend, on similar lines to the six-year-old's 4F (he's eight now!) and it would work in very well. As near as I can recollect, "Helen's" three cylinders are $\frac{13}{16}$-in. bore and $1\frac{1}{4}$-in. stroke; and these dimensions, at a time when the "laws of the Medes and Persians" laid down that two cylinders $\frac{5}{8}$ in. by 1 in. was the absolute maximum for which a $2\frac{1}{2}$-in. gauge locomotive boiler would supply steam, properly put the cat among the pigeons, and raised the usual moans. One thing that Messrs. Theory, Orthodox and Co. couldn't find fault with, was the adhesion; eight-coupled wheels in the middle of a hefty locomotive, take some spinning!

Flat slide-valves are used, with steam chests having large circular bosses to imitate piston-valve casings. The lubrication system was designed by Mr. Josslin himself, and consists

of three drum-type lubricators, one for each cylinder, working on the displacement principle, and delivering oil direct to each steam-chest *via* a screw-down valve. The valves can be seen in the picture, projecting through the "step" in the running board. I had not at that date done anything in the way of mechanical lubrication, or "Helen" would have had a "force-feed"; however, Mr. Josslin's idea has panned out all right, and given no trouble.

The outside valve-gear was easily made to suit the "picture," and is a plain Walschaerts with the lifting-link ahead of the expansion-link, the latter being carried in a bracket of the L.N.E.R. type. I preferred the girder pattern, but the blueprint showed an open bracket, so it was fitted. The drive is divided, the inside cylinder driving the first axle, and being set well ahead. The Walschaerts expansion-link is carried on brackets attached to the motion-plate, and driven by a big eccentric on the crank axle, the two reversing-shafts being coupled in a similar manner to those on the "Lassie." There is nothing else of special interest in the chassis, but the few good folk who saw it under air test before being sent off, were tickled by the even turning movement of the three cylinders. The late Mr. A. M. H. Solomon was especially enthusiastic; he said the chassis would have made up very well into one of the big French locomotives, which he knew very well, having frequently to visit France on business, and had made many trips on the footplate. In due course the chassis was packed up in a stout case, and handed over to Messrs. Thomas Cook, who delivered it safely to our friend in Toronto. Other oddments followed, and eventually the whole bag of tricks was erected at its future home town, "Bro. Alex" having the satisfaction at last of seeing one of his dream-children come to life.

"Helen Long" has proved that Mr. Josslin's ideas of proportion were perfectly sound, embodying an extremely powerful and speedy engine within the limits of the load-gauge, yet looking like a locomotive and not a hideous freak. Many readers of these notes who, like myself, love to see grace and symmetry even in such a utilitarian object as a steam locomotive, will pardon me for saying that some designers of ultra-modern haulage power might do worse than take a lesson from builders of little engines, on the subject of combining great power with a good personal appearance. We hear much of "revolutionary" designs; I might retort that the "revolutionary" part of the business should be in the wheels, and they can "revolute" just as swiftly and powerfully on a good-looking engine, as on an awful nightmare. 'Nuff said!

"Helen" has now "come of age," and is as lively as she was when first assembled; she "celebrated" when opening the new track of the Toronto club, as mentioned a short while ago in these notes. She has done a fair amount of work; in addition to track running, she has been run all day on several occasions, with the wheels jacked up and the cylinders connected to a compressed air supply, at exhibitions in the city stores. The valve-gear joints are now showing signs of wear; nevertheless, says Mr. Josslin, the turning movement and the exhaust beats are still quite even, which he thinks is good evidence that they were right at the start. A couple of days in the shops would soon restore the *status quo*. Well, good luck to the old girl, and her genial owner; she was the forerunner of many other "Helens," as I described in detail, in the early days of the "Live Steam" notes, how to make a similar locomotive. Strangely enough, only last week I received a letter from from a correspondent who wanted to know whether castings and material were still available, as he had been reading some old back numbers, and had taken a fancy to "Helen Long." Old engines never die!

"Hielan' Lassie"

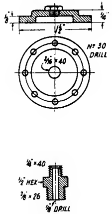
How to Test the Boiler

Before making any of the fittings and mountings, the boiler should be tested to twice the working pressure, by means of a hydraulic test; then, if anything is going to give way, it will do so without the slightest danger to the operator. All you require for this purpose are: a pump with a piece of pipe and an adapter to fit one of the safety-valve bushes, and a pressure-gauge reading to 250 or 300 lb. per square inch. The engine's own tender pump will do fine for the former requirement; as for the latter, I use a full-sized locomotive steam-gauge reading to 360 lb., which was purchased new in 1919 or thereabouts, at a well-known engineer's stores in London, for the princely sum of 12s. 6d. It is still correct to a couple of pounds, and I use it not only for boiler testing, but for checking and resetting small pressure gauges, and setting safety-valves. The only preparation needed on the boiler itself, is to plug the regulator bush and steam pipe holes with screwed plugs which can be turned out of any suitable short ends of brass rod that may be handy; turn and fit the cover for the dome bush, and make a couple of adapters to fit the safety-valve bushes, one for the pressure gauge pipe, and one for the pump.

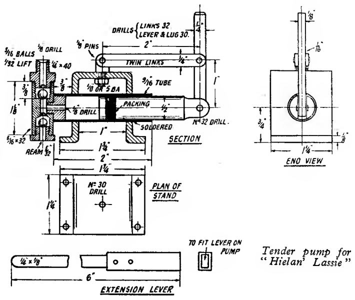
The dome bush cover is another kiddy's practice job. Castings will probably have a chucking piece on top, and if this is held in the three-jaw, the contact flange can be faced and turned to $1\frac{1}{2}$ in. diameter at the one setting. Reverse in chuck and hold by the edge, like a cylinder cover; the chucking piece can then be sawn or parted-off, and the top of the flange turned to form a true seating for the fixing-screws. A $\frac{3}{16}$-in. by 40 hole can be made in the middle of the cover, and a plug fitted, for oiling the regulator-valve. Drill the screw-holes as shown, and fit the cover to the bush exactly as described for cylinder-covers. Make a gasket from 1/64-in. Hallite or similar jointing, and place between the faces when assembling. The adapters are shown in the illustration; They are made exactly as described for the fitting on top of the engine pump valve-box, so detailed instructions are not needed.

Tender Hand Pump

This can be made now, for carrying out the test, and put aside until the tender is made.



Dome cap and testing adapter



Tender pump for "Hielan' Lassie"

With an eccentric-driven pump, and an injector, it will probably never be needed in service, but is good insurance, in a manner of speaking. If a strange and inexperienced driver lets both steam and water down, it comes in handy; also will be useful for bringing up the water level before lighting the fire, when needed. No castings are required. The stand is bent up from a piece of $\frac{1}{8}$-in. brass or copper, $1\frac{1}{4}$ in. wide and approximately $4\frac{3}{4}$ in. long, and has a $\frac{1}{2}$-in. hole drilled through each side for the pump barrel, which is a piece of $\frac{9}{16}$-in. brass treblet tube 2 in. long. Square off both ends in the lathe, then turn a plug to fit tightly in one end, the plug being drilled $\frac{1}{8}$ in. or No. 30, and turned and screwed $\frac{1}{4}$-in. by 40 on the outer end. The valve-box is made from a $1\frac{1}{8}$-in. length of $\frac{7}{16}$-in. brass rod, drilled, reamed and tapped as described for the engine pump, but to the sizes shown in the drawing; it has a $\frac{1}{4}$-in. by 40 tapped hole in the middle of its length, by which it is attached to the barrel. Push the barrel through the holes in the stand, with valve-box vertical, and then solder the joints, and the connection between barrel and valve-box. The ram is a piece of $\frac{1}{2}$-in. brass or rustless steel rod $2\frac{1}{4}$ in. long, with a packing-groove at one end, and a slot and cross hole at the other. The lever and links need no description; the latter are anchored to a lug made from $\frac{1}{8}$-in. by $\frac{1}{4}$-in. brass rod, and attached to top of stand by a nut. The pins are $\frac{1}{8}$-in. bronze rod; if at all loose, rivet the ends over slightly. The illustration shows the complete assembly, and is self-explanatory. Any beginner requiring detailed instructions should look up those for "Petrolea's" tender pump.

To test, completely fill the boiler with clean cold water through one of the safety-valve bushes; couple the pressure-gauge to one adapter, and the other to the pump, by a piece of $\frac{1}{8}$-in. or 5/32-in. tube furnished with $\frac{1}{4}$-in. by 40 union-nuts and cones. Stand the pump in a shallow bowl of water, put on the extension handle, and operate for a few strokes. When the gauge indicates 50 or 60 lb. take a look at the boiler and see if anything has happened. If leakage starts, correct before proceeding. Then increase pressure by stages, till you reach 160 lb. If the crownsheet moves slightly, don't worry, it will only be the soft copper settling itself in the best position to resist- pressure. If you reach 160 lb. with no leaks and no failure of any joint, you can safely pass the boiler as O.K. Leave the pressure on for a little while, and then, if nothing has happened, let out the water. The next job will be to make smokebox and fittings.

NEW LOCOMOTIVE CASTINGS

H. Clarkson, 30, George Terrace, Barlby, Selby, Yorks, has sent us a copy of a price list of castings for $3\frac{1}{2}$-in. gauge locomotives. He specialises in castings for the L.N.E.R. Class B1 4-6-0 engine *Springbok*, which is a handsome and popular type and, in $3\frac{1}{2}$-in. gauge, should be a powerful passenger-hauler. The range of castings is a wide one; and, since many are of L.N.E.R. standard pattern, they can be used for other types of engines, including the Gresley and Thompson 4-6-2 designs. The price list gives particulars of drawings which Mr. Clarkson can supply; these include, not only the *Springbok*, but a number of "O" gauge locomotives, for which a limited number of castings can be obtained. A miscellaneous selection of other castings is available in 10-mm. scale. Readers should write to Mr. Clarkson for a copy of his list.

J. W. Pattson

Relates his Experiences in

CINÉ DESIGN

THE recent discussions on the design of ciné-projector mechanisms prompts me to write of a few observations resulting from my own experiences in this particular field.

Prior to the war, I was an active member of a ciné society and, being fond of making things, soon got the urge to build my own projector, which eventually ended up by building a complete home cinema in a spare room.

Projection was as nearly perfect as I thought it should be, and certainly was as perfect as I could make it, at the time, using home-made 16-mm. apparatus.

Unfortunately, with the coming of the war and having to move to another house, I disposed of all the paraphernalia. However, I hope to start again in the near future, using 8-mm. film, and if results turn out as good as with the 16-mm. previously used I will be satisfied.

Before describing the projectors it may be of interest to those intending to take up this pleasant hobby to know how pictures were shown in my own particular case. I will have to be brief, as a detailed description would take up quite a lot of space.

For the cinema, a narrow room some 21 ft. long was chosen, one end of which was blocked off, to the depth of about 15 in., with a mock wall and decorated to match the rest of the room. An opening, somewhat larger than screen size, was left in this wall, framed with a suitable moulding, to form the proscenium, and the opening covered with heavy velvet curtains. On the original house wall, seen through this opening, a permanently-fixed glass-beaded screen was erected and in front of this hung grey-coloured silk curtains to take the lighting effects. The latter were provided from below-stage by a revolving octagonal drum-shaped framework, covered with strips of cellophane in various colours and illuminated from the inside. On the mock wall in front of the proscenium and extending just below it, a housing enclosed a miniature cinema organ, complete with organist in evening dress. The organ was illuminated and was capable of being raised or lowered. Below the organ housing there was a loud-speaker suitably housed behind a grille.

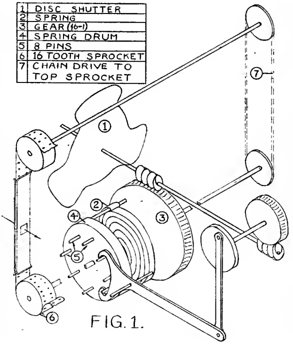


FIG. 1.

The presentation of the programme was as follows : By closing a switch, quite a simple piece of apparatus, dimmed the room lights, started organ music from selected gramophone records on an automatic record-changing turntable, the organ meanwhile slowly rising. Just as the organ came into full view, the velvet curtains began to part, and the stage was gradually flooded with coloured light which merged from one colour to another as the drum below the stage made a complete revolution. With the front stage curtains now fully open, picture titles were thrown on to the grey curtains, and they in turn slowly parted, leaving the picture on the screen. Only a spark of light was left on the organ to add realism after all other lights had been dimmed.

Pictures were run from a 1,600-ft. reel and occasionally were in colours, all, of course, self-taken with a ciné camera. Success called for extreme

reliability of machine, and, to aid this, all film had to be kept in perfect condition by being carefully stored in humidor cans and rewound on a separate rewinder after the performance.

By this time, I began to think the hobby was getting somewhat expensive, so a drop to the 8-mm. size was considered advisable, as it appeared to offer several advantages, two of the most important being less expensive to run and a more compact outfit, 8-mm. film being only one-quarter the bulk of 16-mm. This decision was only to be taken should it prove possible to project this size equal in every way to 16-mm., when using an average room-sized screen or, say, a picture size of not more than 4 ft. by 3 ft. I was a bit doubtful at the time as to whether this could be accomplished as the results of a try-out of one or two commercial machines proved disappointing. Eventually, I did witness a demonstration of a somewhat expensive 8-mm. projector which gave a picture equal to that of the best 16-mm. and, what was equally pleasing, it was the most silent-running machine I had come across. Success was in no small measure due to the high-grade lens with which the projector was fitted, and, at that time, that particular component was difficult, if not impossible to get hold of, for anyone wishing to construct his own machine. Later, a ½-in. lens of high quality with an opening of f/1.6 dia. appeared on the market; but unfortunately, by the time I had decided to buy one, war appeared to be just around the corner, and I gave it up.

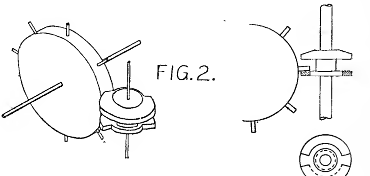


FIG. 2.

Reverting back to 16-mm., the successful results with home-made apparatus called for a lot of experimenting and, altogether, three progressively successful machines of 16-mm. and one of 8-mm. were built, together with a host of experimental mechanisms. I was fortunate in being able, from time to time, to witness a demonstration of nearly all the sub-standard machines on the British market through being a personal friend of a ciné dealer.

Having these very definite ideas as to what constituted a perfect ciné projector, these demonstrations somewhat upset my theoretical ideas; so much so that I began to wonder whether my ideals were worth striving for. Briefly, I visualised a high-class lens to take care of definition with a large aperture to pass as much light as possible, the minimum of black-out on the shutter, as quick a frame-to-frame transference as possible without damage to the film, with film, condenser, lamp and reflector bunched up as close as possible to prevent waste from scattered light, resulting in a small-power lamp for a given brilliance on the screen. Only a definite amount of light is required to reach the screen, as too much will penetrate the blacks of the film, turning them grey, and at the other end of the scale lose the tones of the highlights.

A Surprise

The results of these demonstrations showed very little difference in machines having a 4-to-1 and a 10-to-1 intermittent action. Another surprise was in the size, or rather power, of the lamp; and, as a rough test, two machines were placed side by side, one with a 750-watt lamp and the other with only a 200-watt lamp, both equipped for the test with excellent lenses. With this test, one would expect dazzling brilliance on the one hand and dullness on the other, but the difference was hardly noticeable. Changing to a 400-watt lamp gave a similar result and, from this, it would appear that a 300-watt lamp should fulfil all requirements. In a hall and showing a larger picture, there is no doubt the 750-watt machine would show up to advantage. Measured in terms of lumens, the strength of the light would be different, but to the naked eye there appeared to be a wide latitude in the choice of lamp power.

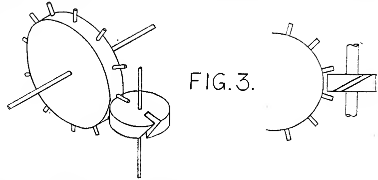


FIG. 3.

Substituting the high-grade lens with the less expensive one supplied with the 200-watt

machine, did, however, make an enormous difference both in brilliance and definition, so it obviously pays to buy the best lens one can afford.

Lenses last for ever, but lamps do not; and a high-powered one can be costly and last no longer than a low-powered one which is correspondingly cheaper, so the moral is obvious!

Of the machines demonstrated from time to time, one was a Maltese-cross, one an octo-cross, several with patented intermittent movements, with the bulk using various types of claw movements. Some had barrel-type shutters, whilst others were of the disc type. As far as the resulting picture was concerned, there was little to choose between any of these machines; but reliability, silence and ease of control varied considerably. For instance, several of the claw machines ran the film through without a hitch, whilst others did just the reverse; a bad splice or a slightly damaged perforation would cause a stoppage.

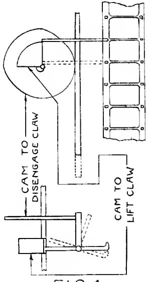


FIG. 4.

With all this accumulated data to go on, a start was made to collect the components that had to be bought, such as a high-grade lens with wide aperture, a low-voltage 300-watt lamp, together with several condensers from commercial machines.

First, a sprocket-driven machine was designed as sketched in Fig. 1. The object was to use a larger sprocket than was possible on a Maltese-cross machine and with an attempt to speed up the frame to frame transference, making the pull-down variable allowed for testing three- or four-bladed shutters with wide or narrow blades. It will be noted that the action is not unlike the escapement of a clock. The power is transferred from a constantly-rotating wheel, through a wound-up spring to the spring-drum, having accurately-spaced pins set around its face, the exact number depending upon the size of the sprocket-wheel. In this case, eight pins were used, necessitating a worm-driven reduction of 16-to-1 and a 16-toothed film sprocket. A disc-crank provided the oscillating motion to the pawls. Being spring-driven, the speed of transference from frame to frame was governed by the degree of tension given to the spring, this being accomplished by a serrated disc, not shown in the sketch, forming the attachment to the worm-wheel. Any slight reversal of the drive unwound the spring, so a simple ratchet arrangement was used to counteract this. I might add that I have never had any desire to possess a machine capable of running in the reverse direction. Fitting the disc-shutter was a simple operation, as one had only to increase spring tension until ghost effect disappeared. For experimenting with shutter and flicker-blade widths, narrow overlapping blades were used.

Complete Reliability

This machine was very successful and projected an excellent picture with complete reliability, and no apparent wear showed on the film, thanks to the large sprocket; but the loud clicking noise set up by the pins coming into contact with the pawls was annoying, though much of it could have been eliminated by using light alloy for the spring drum and sprocket. The motor also was none too good and silence was not one of its virtues. However, this machine ran quite a long time before it was decided to make alterations. The first alteration was to do away with the oscillating pawls and substitute two rotating cams. This time, pins were spaced around the rim, each pin being checked first by the top cam and then by the lower one. This arrangement is shown in Fig. 2, and resulted in an improvement in running; but it was soon abandoned to make way for a single cam, Fig. 3, with a slot suitably shaped to accelerate and decelerate the pins gradually and thus prevent the sudden jerk on the film. In this way the speed of transference from frame to frame was controlled by the angle of the slot in the cam. The cam was a simple lathe job compared with the making of the pawls.

Having been successful so far, it was decided to investigate the possibilities of a claw machine, again making use of a spring to pull down the film, Fig. 4. Both single and tandem claws were tried.

Compact Movement

Claws were held in engagement by a spring and pulled down by another, their anchorage being made adjustable. Cams controlled the rest of the movement. These are drawn in simple outline, though in practice they were carefully shaped to provide a smooth movement and allow a controlled drop, after which the claws were raised ever so slightly before being withdrawn from the sprocket-holes. Though not apparent in the drawing, this movement was very compact and the claw part was literally as light as a feather. Eventually, after many adjustments, it was set with a picture shift of 8-to-1 ratio, this allowing for a reasonably small obturating blade on the shutter. The latter, being of the disc type, was three-bladed with flicker and obturating blades all alike.

I liked this machine very much, though it did cause trouble if a badly-damaged film was passed through it. On the other hand, it was well-nigh perfect given a good film.

Various other more or less ingenious claw-driven "set-ups" were attempted, but discarded before they got built into a complete machine.

Then a movement was constructed without any experimenting, it being more or less a copy of a well-known and popular British machine, using all-spur-wheel drive, drum-type shutter with a single blade running at high speed and a claw at both sides of the film, the latter operated by two disc-cranks. Due to the type of shutter used, no right-angled drive was necessary, though quite a lot of gearwheels had to be employed. As was to be expected picture results were perfect, but the whirring noise created by the many gearwheels in their brass case rather put me off. Having a claw engaging each side of the film, only very occasionally was there a stoppage and had it not been for the aforesaid noise it would have been built into a complete machine.

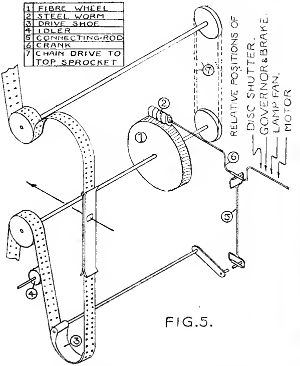


FIG. 5.

Overcoming Faults

Next attempt was to eliminate the wear on the perforations of the film and to overcome some of the other faults which had been experienced. To get silence, as much gearing as possible was done away with and what was thought to be a final design, at least at that time, was planned out. It will be noticed from Fig. 5 that the positioning of the motor allowed for direct drive with a disc shutter, the right-angular drive to the film-sprocket being by steel worm and fibre wheel, which could easily be made dead silent. The motor, although of the commutator universal type, had evidently been designed to run at slow speed having been taken from a gramophone turntable where it originally ran at a speed of approximately 300 r.p.m. In any case it was just the thing for the job and ran without a murmur. The chain drive to the top feed sprocket running at a slow speed was equally inaudible, so all that was left to ensure silence was to make the bearings a good fit and use a substantial framework.

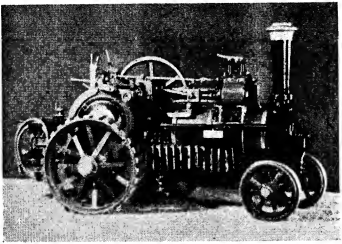
Film transfer was by the aid of a shoe and a moment's reflection will show that, no matter what length of shoe or crank is employed, the film will only move one frame at a time, as the length of film between bottom sprocket and gate always remains the same when the shoe has completed its travel. In this particular design, the shoe did lose contact with the film when the crank was going over top centre; but, nevertheless, it engaged again very gently due to its shape, accelerating the film to maximum and retarding it as the crank passed over bottom centre.

I believe a similar arrangement was used on some of the earliest 35-mm. projectors and later discarded in favour of the almost universal Maltese-cross design. Some of the latest sub-standard machines, just prior to the war, appeared with this movement more or less elaborated, but even in its simplest form as used here it worked extremely well, provided care was taken in the design of the shoe contour, and its relation to the sprocket or idler if one is used. On no account must it be allowed to beat the film as the sudden jerk would be detrimental to the latter. It will be apparent that any speed of film transfer within reason can be got by simply altering the throw of the crank or the length of shoe.

If an adjustable idler is used it will act like a jockey-pulley and increase or decrease the length of film between sprocket and gate, thus serving the same purpose as optical framing.

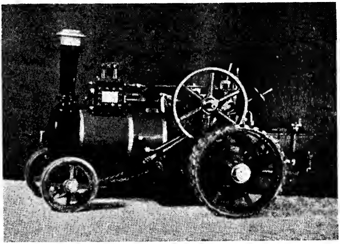
Taken altogether, this was one of the easiest machines to construct and attain the desired results and was so successful both in 16-mm. and 8-mm. sizes, that it will form the basis of any future design. As regards ease of construction, each movement of the film through the gate is automatically duplicated and does not, as in the other sprocket machines described, depend upon the accuracy with which the pins are spaced around the spring-barrel or drum.

Finally, to those who wish to try out the movement, I might suggest that, with a couple of spur-wheels to gear the main crank to the sprocket-wheel and a few small strips of brass to act as connecting-rod, shoe and gate and mounted on a board or sheet of brass, the intermittent action given to a length of film can be closely watched together with a few intriguing problems to solve, and later, let us hope, result in a machine that will work well.



A 1-in. Scale Burrell Traction Engine

By G. R. Cross



A GOOD many readers no doubt will be able to recall having seen a similar photograph to the one illustrated. Yes, I gave a description of the building of this engine a few years back, practically completed, with the exception of one or two fittings I have now added, and the final testing out.

The fittings in question are lubricators to big-end of connecting-rod and weigh-shaft bracket, inspection cover fitted to tender (or washout hole for water tank), water lifter; this, by the way, is about the size of a sixpenny-piece and does the work well, it is built up of brass and silver-soldered, is controlled from the footplate by a wheel valve, steam is supplied by a piece of 3/32-in. copper tube running from the top of horn-plate back bracket, along one side of tender, then across coal bunker front plate, through other side of tender, then connected to lifter, locking at rear of engine; this is fitted on right side of tender, is Burrell style and type, rubber hose is fitted to same, also brass water rose, which is drilled.

The firing, which, by the way, is by coal, proved a great trial, due to the blower and to small bore in the chimney base, so this had to be bored out, the blower had to be remade with a smaller bore; this was made with a piece of 1/8-in. copper tube drawn out to a very fine point, then drilled by a small number drill; this is fitted directly under the exhaust pipe which is drilled to take this. The blower is controlled by a one-way cock between cylinder and chimney. Fire is raised by an auxiliary boiler and blowlamp and extension chimney. Small chips of paper and wood soaked in methylated spirits are used; when this is well alight, then on goes charcoal, treated as above, then on goes Welsh anthracite, and in a very short space of time we have a real good fire going. One has only to open the sliding fire doors to see this grand sight—a real red-hot fire, like her big sisters. As soon as there is the slightest sign of any pressure showing on the pressure gauge the auxiliary boiler can be taken away and blower turned on; this will keep the fire going till further orders; if turned on full, will pull the fire right through and sparks go flying; stea is raised very quickly from cold and the engine will commence to turn over as soon as pressure is showing on the gauge, the beat of the exhaust will keep the fire going, the blower can be shut off. The pump driven from the crankshaft keeps the boiler well supplied with water.

The rear wheels, by the way, are the wrong way round; the strokes should be pointing downwards, nearest hornplates.

This engine has pulled my little son Tony, aged five years, on his tricycle with ease and

(*Continued on page* 53)

A TUBE-BENDING TOOL

By W. T. Barker

BENDING copper tubes has always been rather a bugbear to me, as it is apparently to many other model makers, to judge from examples of otherwise excellent models impaired by poor coppersmithing, noticeable at any model engineering exhibition. I daresay judges turn a lenient eye on it. I know I should myself, but by degrees I got so fed up with my own efforts in this line that I decided that something would have to be done about it, and the tool now to be described is the result.

It is in no way an invention of my own. I have only simplified and adapted a type of rotary pipe bending machine used industrially for years, and applied it to model making uses. The conditions it was desired to fulfil were :—

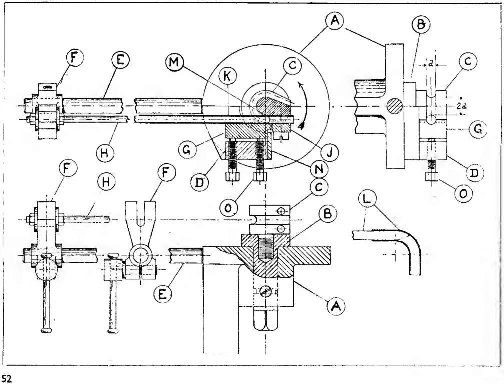
(1) To deal with a range of tube sizes up to ¼ in. external diameter.
(2) Bends to be as close as practicable to 1-1½ d radius.
(3) To bend cold and unloaded and without visible flattening or other deformation of the tubing.

The sketch shows the complete tool as finally developed and description and method of operation and setting is as follows :—

The tool consists of a main body (A) of steel or C.I., provided with a lug for holding in a vice, and carrying a movable spindle (B). This spindle is of steel ½ in. diameter with a head 1 in. × ¼ in., and a squared end to the shank. The head is tapped 5/16 × 26 t.p.i., to hold interchangeable formers (C). (A) also carries a stout fixed angle-plate (D), and an arm (E), 5/16 in. diameter, to which a sliding bracket (F) can be clamped in any desired position. D's function is to hold a pressure die (G) against the tube during bending, while the bracket (F) locates the tube mandrel (H), of which more anon.

A former (C), and pressure-die (G), is needed for each size of tube and for each different radius. An inner bend radius of 1 d (where d is the outside diameter of the tube) is about the safe practical limit for annealed copper. For aluminium or mild steel the minimum should be at least 2½-3 d for cold bending. Considerable force is necessary to make such tight bends, as to 1 d and 3/16 is about the maximum size safe for an inserted former with 5/16 × 26 t.p.i. shank. For ¼-in. pipe I use a separate spindle (B) with former (C) integral.

From the contour of the formers (C) in the plan view it will be seen that they can bend tubes to a little over 180 degrees. The grooves in both formers and pressure dies must fit tube sections exactly to avoid deformation, and the depth of the grooves must not be less than ⅝ d



The extension to the right of the former (see plan view) takes a cap (J) which clamps the tube (K) to it. Tubes are under heavy pull during the bending process and may slip unless clamped tightly. It is advisable to insert a plug in thin walled tubes to prevent crushing when making a first bend.

The tube mandrel (H) is a most important part of the tool. The plan view shows a tube in position ready for bending, and the mandrel must be a good close sliding fit inside it and be held rigidly in position by the bracket clamped to the arm (E). A special mandrel is needed for each bore of tube. I use the nearest silver-steel gauge wire. The fixed end has a screwed portion with two nuts and washers to secure it in the slot in the bracket. (E) and (H) can be of any length required to suit the tubes to be dealt with. Tubing must be straight to start off with.

The free end of the mandrel is nicely balled off in the smaller sizes, and the end well polished but when $\frac{3}{16}$ in. or more in diameter, should be carefully curved (see L) to the inside radius of the bend to give more support.

Theory and Practice

Correct setting of the mandrel is most important for making a good bend. In theory, the parallel portion should reach exactly to the bending point (M), and no farther. In practice the best position has to be found by experiment and experience. It may vary a little, depending on how good a fit it is in the tube or on the wall thickness. Usually it must be advanced very slightly beyond the true bend point up to perhaps 1/64 in. or so. Too much advance, however, will produce deformation by over-stretching, just as too little will allow the tube to flatten slightly.

When the right position has been decided, the bracket (F) is clamped to the arm and after all sliding contacts, particularly the mandrel, have been oiled, the tube is pushed on the mandrel into place and clamped to the former by the cap (J). It now only remains to slip the pressure die (G) into place up against tbe stop (N), and press it lightly, but with no slack against the tube by the screws (O). The groove in the die should also be oiled. The pinching screws must be accurately on the centre line or plane of bending of the tube.

The tool is now held in a vice and a spanner or square hole key applied to the shank end and the spindle turned in the direction of the arrow, sufficiently to make the required bend. To facilitate this the upper rims of the formers are graduated to 180 degrees in 30 degree steps. As the tube is clamped to the former it will, during the turning process, be drawn towards the right and slide along the fixed mandrel, while the pressure die prevents it moving otherwise than in a straight line up to the bend point (M). Bending takes place at this point only throughout the movement, and if adjustments have been well made, a perfect bend with no perceptible flattening or other deformation of the tube will be produced. By careful measurement compound bends can, of course, be added successively on the same length of tube with close positional accuracy, but too closely adjoining bends may need a specially-shaped cap-piece (J).

Bends as sharp as those in question here cannot, of course, be made in soft copper without some thinning of the wall on the outer radius, due to stretch, and some corresponding thickening up of the inside wall by compression. This rotary method, however, has the great advantage over bending done from the centre outwards over a fixed former that thinning is spread equally over the whole length of the outer radius. There is no tendency to concentration or formation of a very thin and weak spot at the crown of the bend.

Improved Results

Some readers of these notes may think that all this is going to a vast deal of trouble and elaboration to achieve what is after all a comparatively minor object. It depends very much on the point of view. I can appreciate the outlook that puts performance first and foremost and appearance relatively low in the scale, and I should agree that to such, this appliance would have little appeal, except, perhaps, as a time saver. I am not built that way myself, and no trouble to my mind is too great if it will lead to an improved result, and I am sure many model engineers will understand the thrill of pleasure it gives one just to see and handle the delightfully accurate products of this little tool.

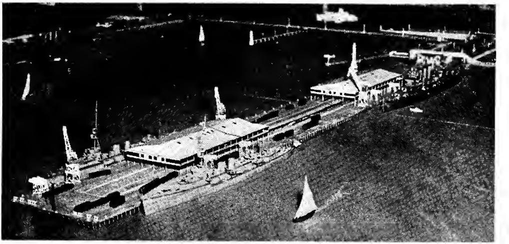
A 1-in. Scale Burrell Traction Engine

(*Continued from page* 51)

without any signs of wheel-slip. The engine weighs 30 lb.

With our Editor's permission, I would like to make a few suggestions to future traction builders.

Build your engines to a prototype; this helps in a lot of ways, if you are unable to get the loan of drawings—a mere picture is very helpful, or go around the country lanes and see the actual thing and measure up; scaling an engine does not matter so much so long as you proportion all the main parts, such as wheels, boiler, chimney, cylinder, flywheel, and get the correct shape tender. The maker's catalogue will help you with all this; some even state size of wheels, flywheels and bore and stroke of cylinders. This is a great help in which to get started on the drawing board. Put plenty of detail into your engines; don't forget to show those rivets on each side of hornplates. Try and coal-fire your engines; difficulties arise but are soon overcome with patience, which is the making of a true model engineer.



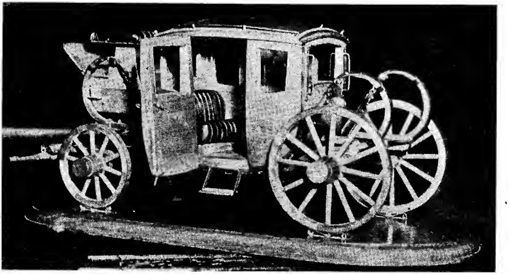
AUSTRALIAN MODEL SOCIETIES HOLD FIRST BIG POST-WAR SHOW

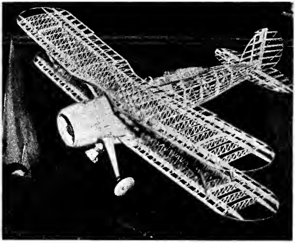
THE skill and ingenuity of Australian model builders was revealed at an exhibition recently held in Melbourne by the Australian Association of Model Societies. It was the biggest models exhibition yet held, and was made possible by the amalgamation of five model societies, the Model Power Boat Society, Model Railroad Club, the Ship Modelling Society, and the Victorian Model Aeronautical Society, all with club headquarters in Melbourne. The purpose of the show was to raise funds for the Flying Angel Seamen's Missions.

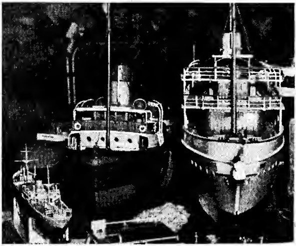
Set in Melbourne's Town Hall, the display of all types of models—from wood carvings of ancient muzzle-loading guns, to steel replicas of modern tanks—attracted the school children of Melbourne, who were on term holiday. Many thousands of adults also visited the exhibition, giving a total attendance of 50,000 people,

An outstanding feature of the show was a model railroad, built by the Model Railroad Club. The exhibit was laid on an oval stand, 24 ft. long and 18 ft. wide, with over 300 ft. of electrified tracks, which carried scale models of most types of locomotives and rolling stock, including British, Australian and American type engines.

The Model Railroad Club is run to conform to the system of management of the various State-owned railways in Australia. It has a chief commissioner, chief mechanical engineer (who allots construction work to members), designers, electricians, boiler makers and many others whose positions in the club correspond to callings in real life.—LEN BARKER.







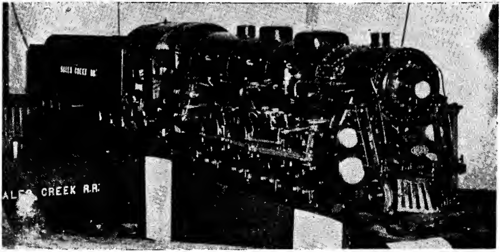
(1)—*A view of Port Melbourne diorama. In the foreground is Station pier with the two Royal Navy Cruisers, " Danae " and " Diomede," nearest the camera. At the other end of pier is model of the Royal Australian Navy cruiser "Australia." This particular diorama was one of the many built by Australian model societies during the war*

(2)—*An intricate wood model of early American stage coach. This exhibit is fitted with springs and leather upholstery. It was built by a member of the Ship Modelling Society in his spare time*

(3)—*This model of a Gloster Gladiator aircraft took six years to build. It was made by a member of the Victorian Model Aeronautical Association. Model is built to exact scale from blue-prints of full-size Gloster Gladiator. It is fitted with aileron controls which operate perfectly*

(4)—*Some of the marine models*

(5)—*A large model of New York Central Mountain-class locomotive. It was built in twelve months by Mr. Roy Hughes, a Melbourne engineer. The model is 11 ft. 6 in. long, built to a scale of ¼ in. to the foot. The engine can pull eight men at 25 miles an hour*



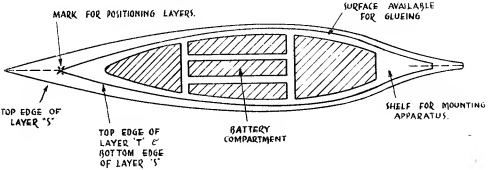


Fig. 4

*Beginning with "*PEROMA*"

By Colonel J. B. Adams

I MADE no attempt to smooth off the inside of the hull, first because it would have had to be done with a chisel and been a most laborious process; secondly, because on weighing the hull I found that it was within the weight I had calculated, and thirdly, because the "steps" thus left inside the hull would be useful for mounting apparatus.

The final parts of the hull requiring attention were the top portion forming the "sheer" and the deck, which were, in fact, not made and fixed in position until much later when the interior fittings were finished. The sheer was made by cutting out two pieces of 5-ply wood to the correct shape, after which they were steamed and bent to the shape of the deck line, and then glued and nailed on to the top edges of the hull. I was surprised to find, incidentally, that, provided the curve is not too sharp, ply wood can be steamed and bent without disintegrating.

**Continued from page* 7, "*M.E.*," *January* 2, 1947.

The deck was cut out in one piece from a 1/8-in. sheet of 3-ply (without any particular history attached to it!). Lines to represent the planking were drawn on it with a hard-pointed pencil and then varnished over. Three portions were cut out of the deck to allow access to the interior, as shown in Fig. 6a. In the case of the fore and aft holes, equivalent pieces of decking were made to fit into the gaps resting on ledges underneath and secured in place by catches. The centre hole is filled by the dummy deckhouse (Fig. 6b), which is merely a tight fit, and lifts out for access to the main switches. A major problem was how to keep water out, as I could see no way of making the various openings that were necessary in the deck waterproof. In practice, however, it has not caused difficulty, and the boat will sail at an angle of heel of some 45 degrees in quite rough water and with the edges of the deck awash, without a drop of water getting inside—which is just as well in view of all the bits of apparatus there which certainly would not be improved by a soaking.

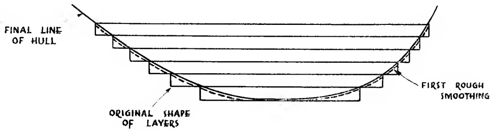
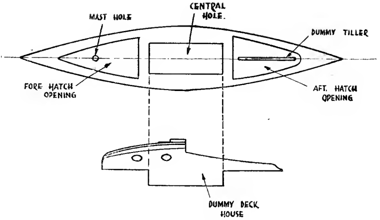


Fig. 5



Figs. 6a and 6b

Mast and Sails

The mast is a light metal tube cut from the remains of a rod aerial from an old wireless set, and is, of course, detachable from the hull. I was fotunate in finding two small ball-bearings amongst a pile of scrap German equipment, which, incidentally, provided many odd bits of apparatus which "may come in handy some day" (I'm sure that must be the model maker's motto). These bearings, about ⅜-in. diameter, have a central hole just large enough after some filing for the mast to pass through, and are therefore mounted one just below a hole in the deck and one in the bottom of the boat, as the bearings for the mast. Again, a friend kindly gave me what must, I am sure, have been a precious possession, a small ½-in. diameter ball-bearing, which I mounted in a block of ebonite to form a bearing at the top of the mast. The backstay (a piece of strong fishing line) leads from this block to the stern and is adjusted to give a slight backward bend to the mast. Although not necessary as rigging, there is also a thin copper wire from the stem to this same block which does duty as the aerial for the receiver.

I found it a very difficult job to discover just how big the sails should be, and I gathered from books on the subject that calculations in this respect are not the best guide, but rather that experience gives the best answer. As I had none of the latter commodity, I made the height such that I thought it "looked right," and then made the sail as large as possible within the limits set by the height and the position of the mast; it would be easy to cut some off later if necessary.

In fact, I not only had to cut quite a bit off the back of the sail, but also had to move the mast forward some 3 in. to prevent the boat luffing into wind all the time. I had chosen the mast position so as to bring the centre of effort of the sail plan about 15 per cent. of the L.W.L. length forward of the centre of lateral resistance of the hlll. In fact, this was not nearly enough, and my own explanation is that when a wedge-shaped hull is moving through water the effective centre of pressure is well in front of that calculated for a flat underwater profile. Perhaps someone with experience will be kind enough to tell me if that is a reasonable explanation.

The two identical sails were cut from an old sheet, fortunately worn a bit thin through age and much washing, and hence lighter than they might have been, though they are still strong enough for the purpose. The edges were hemmed and the luffs of the two sails sewn together (my determination to do everything myself broke down here, and my wife came to the rescue). I then glued the joint on to the front of the mast, and cutting a piece of thin imitation leather (from an old car seat) into a wedge-shaped strip, glued this over the joint and front portions of the sails. Then, using strong thread, I sewed (myself!) the two rear edges together in a criss-cross pattern round the back of the mast. This arrangement, which is shown in Fig. 7, gave four advantages:—

(*a*) The sails were firmly fixed to the mast.
(*b*) When sailing into the wind, the leeward side of the sail comes away from the mast more or less at a tangent, thus promoting smooth air flow.
(*c*) When running with the sails opened out, the weight of wind pressure is taken by the leather and the thread round the back of the mast.
(*d*) From a short distance away the leather strip looks like the mast, which actually, of course, is hidden between the sails.

As I mentioned earlier, I had to move the sail plan forward to prevent luffing, first by cutting away some of the sail and then moving the mast forward. Even so, there is still a slight tendency to luff, so I have made a small jib which can be added and allows a straight course to be sailed without weather helm. This, when rigged, prevents me from reefing the mainsail, so I have also made two light booms for the mainsails for use at the same time. I found that the addition of these booms allowed a better set for the sails when running. They and the jib can be seen in most of the photographs. The booms were made from the thick copper wire out of the edge of an old lampshade, with wire from paper clips soldered to the ends, a loop at one end to go round the mast, and a hook at the other to fit into a string loop on the heel of the sail.

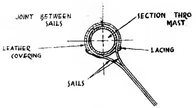


Fig. 7

Mechanical Controls

Except for solenoids which control the rudder, all other functions are controlled by the 6-volt electric motor mentioned earlier. With the assistance of switching devices, gearing and other gadgets, it drives the propeller forward or in reverse, drives the winch for pulling in or letting out the main sheets, and provides the power for the reefing of the mainsails. Having cut away as much of the casing of the original windscreen wiper as possible, and removed the reciprocating parts, I was left with a final drive to a gear wheel of about $1\frac{1}{2}$ in. diameter *via* one of about $\frac{3}{4}$ in. diameter. Into the larger of these two I drilled a central hole to take the spindle of the mainsheet winch, and into the smaller I drilled and tapped a central hole into which I screwed and soldered a short shaft which starts off the propeller drive. The general layout is shown diagrammatically in Fig. 8, though the relative positions and sizes of certain parts have had to be changed for the sake of clarity. The diagram is drawn with the drive on "power," this position having been achieved by temporarily energising the switch S1, whose armature provides the bearing at one end for the shaft (A) which is fixed to the mainsail winch (W1); the bearing for the other end being the short rod (B) mentioned above which runs free in holes drilled into the winch shaft and the large gear wheel shaft.

The two switches which perform the change-over from power to sail and *vice versa* were adapted from the coils and armatures of two old trembler bells, and are ideal for the purpose, since they give a good strong pull over a movement by the end of the armature of up to $\frac{1}{4}$ in., and the return springs shown as separate in the diagram are, in fact, the normal mounting springs for the armature.

The two winch drums W1 and W2 were cut and turned out of an aluminium sheet about $\frac{3}{8}$ in. thick, nearly all the rods used as shafts are brass, about $\frac{1}{8}$ in. diameter, and the collar (C), which is in fact, the clutch, is also brass. This collar was turned, drilled and filed to function as follows: it runs freely on the propeller shaft and on the short shaft (D) which is fixed to the small gear-wheel shaft, these two shafts meeting somewhere near its centre. At its inner (engine) end it has a horizontal slot cut in which rides a steel pin (E) driven through the shaft D, so that it always turns with and at the same speed as the smaller gear wheel. In its centre there is a groove in which runs one rim of the mainsail winch W1, and also a lever fixed to the armature of switch S2 when on "power." At its outer (propeller) end it is cut into a series of notches which engage with a four-armed brass collar (F) fixed to the propeller shaft, again when on "power."

Thus when the switch S1 is operated, its armature pulls the winch W1 clear of two pegs screwed into the face of the large gear wheel and which engage, when on "sail," with notches cut in the edge of the inner rim of the winch. At the same time, the outer edge of the winch riding in the groove of collar C moves the latter outwards until the armature of switch S2 drops into the groove and holds it in position, and the notches of collar C engage with the arms of the collar F. The winch then runs free and the propeller shaft is driven at the speed of the small gear wheel.

When it is required to switch over to "sail," the switch S2 is momentarily energised and its armature moves out of the groove in the collar C, which allows the spring on the armature of switch S1 to move the winch W1, and hence the collar C inwards. When the motor is next started, the winch and collar move their full distance inwards

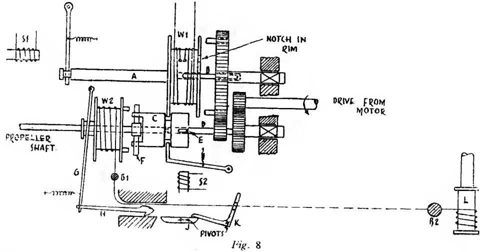
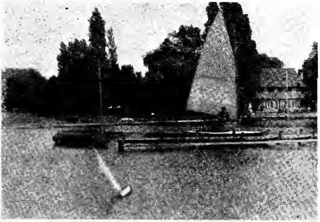


Fig. 8

"Peroma" among her big sisters



when the pegs on the large gear wheel engage in the slots on the inner rim of the winch; collar C then being disengaged from the arms of collar F and the propeller shaft is disconnected.

Reefing the Mainsails

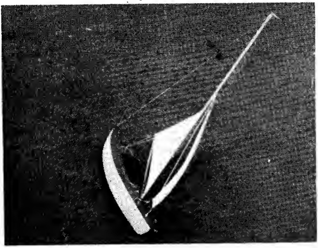
The arrangements for reefing the sails probably caused me more trouble and unprofitable work than any other bit of the boat. My original idea was for the mast to wind up a spring when the sail was set, which would be released when I wanted to furl the sail. In the end, however, I decided to use the motor to do the job automatically whenever I went over from "sail" to "power." A tricky problem then arose; the requirement was that when the sail was pulled out to its full extent—in fact, at the moment when it reached full extension—a clutch would engage so that when the propeller shaft next turned, it would revolve a winch to turn the mast until the sail was fully reefed, and then disengage itself, but be ready to function again should the sail be reset. I tried and made all sorts of devices, many of which failed because they relied on the relative strengths of several springs, systems which I found were almost impossible to adjust. I finally adopted the one illustrated in Fig. 8, which does work very well. The vital bits in this are two ordinary glass beads of different sizes (B1 and B2) kindly supplied from stock by my daughter. The winch W2 runs freely on the propeller shaft and has on its inner face a series of bosses which can engage with the arms of collar F to lock the winch to the propeller shaft when necessary. To its outer face is fixed a collar which engages in a fork-shaped lever G, pivoted at one end and having a spring tending to disengage the winch from the propeller shaft collar F. Pivoted to the other end of lever G is a further lever H with a double hook at its far end which travels in a fixed rectangular-shaped "tunnel" as shown.

On the bottom of the mast, and keyed to it, is a drum (L) made from a cotton reel, and from this a string leads through a hole in an angled lever K, through the tunnel, and on to the winch W2. Fixed on to the string are the two beads and their positions are adjusted so that the whole gadget works as follows.

When it is desired to sail, the winch W1 is driven to wind in the mainsheets and pulls out the sails which previously had been furled up round the mast, thus revolving the mast until the sails are fully extended. As the mast revolves the drum L winds in the string and unwinds it from the winch W2 which is running free on the propeller shaft. When the sails are nearing the fully unfurled position the small bead B1 enters the tunnel, and its size is such that it must pull the lever H, and hence the lever G, inwards, causing the winch W2 to engage with the collar F. After sufficient travel to ensure this, the lever H hooks itself on to the edge of the tunnel, and only when this happens can the head move onwards (if necessary through the hole in lever K) until the sails are fully unfurled.

Thus all the time the boat is under sail the winch W2 is engaged with the collar F, which is

Running well in a bright breeze with mainsails divided



"Full and by"

fixed to the propeller shaft; letting out or pulling in the sheets has no further effect, since the mast does not turn, and the propeller shaft is disengaged from the motor.

On subsequently switching over to power and driving the propeller shaft forward, the winch W2 winds in the string, hence unwinding the portion on the drum L and revolving the mast to reef the sails. This process will continue until any previously decided amount of reefing has been achieved, when the large bead B2 reaches the lever K (through the hole in which it is too large to pass); this lever, *via* the short intermediate one J, forces the hook of lever H back into the tunnel and allows the spring on lever G to disengage the winch W2.

All the levers used for this gadget were cut and filed from the chassis of an old German wireless set which was made of some form of light aluminium alloy.

Propeller and Propeller Shaft

I don't think there is anything of particular interest in these, but I propose to include a drawing in the hope that someone will tell me if the method I used was a reasonable one, and, if not, a better way of doing it. I was told that the simplest housing for a propeller shaft was a block of lignum vitae, but a lot of enquiry failed to lead me to even the smallest block of this commodity. The two blades of the propeller were cut and filed from $\frac{1}{16}$-in. brass sheet, soldered into slots cut diagonally in a collar and then bent by hand to the desired shape. The general layout is shown in Fig. 9. I had to insert the small gear box when I found that the propeller speed was too slow. In making this gear box I had the greatest difficulty in making it run smoothly until I inserted the distance-piece in the centre of the layshaft.

Steering Control

Here again the problem was rather a difficult one, and I thought from the beginning, and still think, that the best method of control would be a separate small electric motor, but so far I have not been able to get hold of one, and have been forced to rely on solenoids to do the job. I have not yet discovered any simple way of making a solenoid slow or partially acting, it is either all or nothing. On the other hand, if I found it necessary when sailing to apply permanent helm in order to maintain a course, it would mean full helm and a steady drain on the batteries. I therefore made and tried out various mechanical gadgets until I finally produced the one illustrated in Fig. 10, which gives me five positions for the rudder, i.e. hard over port or starboard held by the solenoid, half over port or starboard held mechanically, and central (but held by water pressure only). The rudder itself is pivoted on a peg at the bottom fitting into a hole in a brass extension at the bottom of the hull, whilst a shaft at the top is keyed and screwed into the top of the rudder, and carries the tiller arm.

Referring to the diagram the action is as follows: supposing it is desired to move the rudder to starboard, a current is passed to energise the solenoid B, which pulls the iron bar to the right (looking forward). The pin at its centre rides in a slot in the lever C, which being centrally pivoted, moves the tiller to the left, and hence the rudder to starboard to the hard over position, where it remains so long as current flows in coil B.

The Pivot

The pivot (F) for the lever C is not, however, rigidly mounted, but is carried on a further lever G, in turn pivoted to the levers H, so as to give it a slight lateral movement. With the rudder central, the pivot F is prevented from moving laterally by the fixed blocks J and K, but when the rudder is hard over to starboard, the step E is clear of the block K and the pivot F moves to the right until the lever C comes up against the block K. When current is ceased in coil B the water pressure on the rudder tends to centralise it, but when the shelf E comes up against the block K the pressure it exerts is in the direction of the arrow marked (i) and the rudder is therefore held in the half-over position. Thus, if the rudder had been used for a tack to starboard, on release it would take up a position to give slight weather helm whilst on the new port tack.

If the next requirement is a turn to port, coil A is energised and similar operations take place, but this time the first movement would be the pivot F returning to the central position, which it can now do, since the lever C in effect pivots on the pin in the tiller and the pressure is in the direction of the arrow marked (ii), so that the shelf E slides clear of the block K.

(*To be continued*)

Simple Aluminium Casting

By "Battiwallah"

It is quite an easy matter to make simple castings of aluminium and its alloys by the methods to be described. Neither a pattern-maker's or a moulder's skill is required. No claim is made, however, that intricate or delicately-shaped castings can be so produced. The method may be criticised as wasteful of material, but, in the needs of simplicity and expediency, one may prefer to be a little wasteful.

The Metal

Firstly, the source of material. Garages accumulate many discarded pistons which provide excellent material for small I.C. engine crankcase castings and other parts. Many garage owners will, no doubt, be glad enough to give away scrapped pistons to get rid of them. Similarly, discarded aluminium gear-box, engine-sump, and crank-case castings may be acquired, though some little labour is required to break up these latter into fragments suitable for melting down. Then again, domestic aluminium ware whose useful days as such are no more, may find a useful end in the model engineer's melting-pot.

My own most useful gift of material came from Germany, in the form of a Messerschmidt; it crashed near my home and I "found" a sizeable portion as a souvenir, from which I produced some useful castings. But I have no desire to replenish my stock of material from a similar source.

Melting the Metal

Secondly, the means for melting the metal; an old cocoa or treacle tin cut down to a depth of about 3 in. makes quite a serviceable melting pot. It will hold all the metal required for a small casting or an ingot.

Surround the tin with coke in the brazing tray; a half-pint blow-lamp or a medium-sized gas-air torch will prvide all the necessary heat. The quickest way to melt the metal is to play the flame directly on the solid metal; when it has dripped to the bottom of the vessel, concentrate the flame around the bottom outside.

The melting point of aluminium is about 1,200 deg. F. When the contents of the pot attain a dull red heat, the metal is about right for pouring. If the pot has been properly surrounded with coke and the blow-lamp has been kept burning with a strong flame, fifteen minutes or so should suffice for the melting process.

During the melting a considerable quantity of dross will form, especially if the metal was originally dirty, or it consisted of thin fragments. The dross should be removed by skimming the surface frequently with a thin piece of bent-up iron. Aluminium dross is not quite so evident as for instance, lead dross, because it may have the same bright and whitish appearance as the clean metal; it has a spongy nature, and if when the open flame is directed upon a suspected skimming it does not drip, then discard the mass

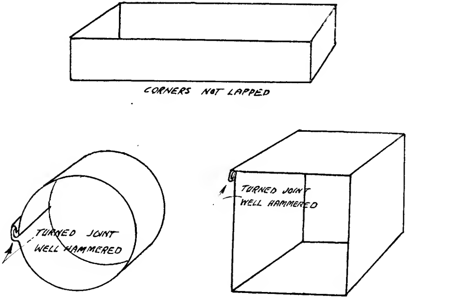


Fig. 1

as dross. Usually the high spots of such a mass when so treated will assume a bright incandescent glow similarly to a gas mantle. The molten metal should be frequently skimmed until only a thin film adheres to the skimmer. Do not vigorously stir the molten metal; this causes porous castings. Moreover, there is a risk of prodding out the bottom of the pot, which, remember, is rather fragile when red-hot; the consequences may be disastrous.

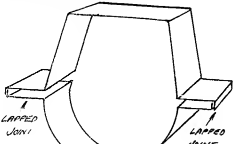


Fig. 2

Simple Moulding

The easiest job of all is making flat, round, or square ingots. Many small engine parts can be made from these, crank-case end plates, for example. One needs only to bend up from thin sheet metal the shapes shown in Fig. 1. Before pouring, place the moulds on a flat surface, preferably a refractory one, and put a small fillet of fine sand around the bottom of the round or square form and at the corners of flat form to prevent the molten aluminium from running out. When cold, the moulds can be peeled off.

A mould for a crank-case casting can be formed by bending up two parallel strips of thin sheet metal into the form shown in Fig. 2. With a piece of similar material at the bottom, embed the mould in dry sand flush with the top; this keeps the two parts of the mould in position during pouring and prevents distortion. The centre of the casting must, of course, be machined away and the shape shown is that for the screw-in type of end covers.

To make a bearing end-plate casting, bend up thin sheet metal to the shape shown in Fig. 3. To form the flange, having first surrounded the bent-up form in sand flush with the top and with a piece of sheet at the bottom, place centrally at the top a heavy round piece of material of suitable diameter, and pack around it additional sand to form a shallow recess. If the sand has been well tamped at the surface level with the top of the bent-up form and care has been taken to avoid letting sand fall into the form, a good clean casting should be obtained. The unwanted parts of the fins can be cut away.

The sheet-metal moulds leave a very clean surface on the castings—almost as clean as die castings. If one desires this finish all over the end-plate casting just described, then by cutting away a flanged sheet as Fig. 4, to receive the form as Fig. 3. and surrounding the assembled form in sand, the desired result is obtained, provided the ribbed form is arranged just flush with the flanged one. If the first projects into the second the casting will be weakened, and it will be difficult to remove it from the mould.

If it is desired to produce the type of casting in which the bearing end-plate is integral with the crank-case, the forms as Figs. 2, 3 and 4, can be combined, in which case it is not necessary to flange Fig. 4. It is, however, very desirable to turn up a wooden form to centralise and

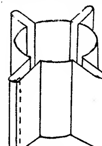


Fig. 3

register the parts of the mould while the sand is being placed around them.

An ordinary earthenware flowerpot is a convenient receptacle in which to place the sand-surrounded moulds.

A word of caution; do not use thick or galvanised sheet iron for making the moulds. The first is apt to chill the aluminium too quickly and the mould will not be properly filled. With the second, the zinc amalgamates with the aluminium, making the mould very difficult to remove from the casting, besides forming on the latter a skin which is too hard to remove by filing or turning.

The war-time metal food containers, being untinned, provide excellent material for Figs. 1

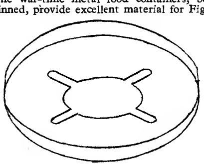


Fig. 4

and 3; just the right thickness and without any coating which will cause adhesion to the casting. It is rather too thin for Figs. 2 and 4, 0.018-in. or 0.022-in. sheet iron is more suitable for these.

Pouring

Molten aluminium is peculiar stuff to pour; it acquires a very large meniscus which causes

(*Continued on page* 65)

"Compensation Without Complication"

By EDGAR T. WESTBURY

THE effect of minor modifications in throttles, air passages and jets can be understood by the exercise of a little common sense. If, for instance, the type of carburettor shown in Fig. 2 is "streamlined" by tapering the bore to form a Venturi tube, it will be seen that the restricting effect on the intake side of the barrel is greater than that on the discharge side, when the throttle is partially closed. (Fig. 6.) Therefore, the tendency is to increase the richness of the mixture at low speed, and this must be counteracted by shifting the jet, cutting away the intake side of the barrel, or providing an air leak around or near the jet. The small "primary choke" fitted to many carburettors may usually be regarded as a fixed (or occasionally variable) air leak, which is not subjected to restricting influence by the throttle or other control device.

No very pronounced difference in the action of the carburettor is produced by substituting a "variable" jet of the screwed needle-valve type for the plain drilled orifice shown, and this is generally desirable on very small engines, owing to the difficulty of calibrating very tiny jets, and their susceptibility to blocking or restriction by minute particles of foreign matter. A variable jet can be cleared in an instant by temporarily opening it wider than normal, but the clearing of a plain jet entails dismantling the carburettor. Control of the jet through some form of mechanical interconnection with the throttle (such as a needle attached to the throttle plunger, common in motor-cycle practice), is liable to be very critical and delicate in very small carburettors, and is not recommended for general use.

Variable Choke Tubes

In view of the desirability of keeping the velocity of air past the jet as near constant as possible at all speeds, many inventors have sought to produce this effect by means of a choke tube which would contract in area, in proportion to the flow of air through the carburettor. A great deal of ingenuity, much of it misguided, has been devoted to this aim, and patents have been taken out for elaborate compound apertures, in some cases resembling the iris diaphragm of a camera lens. It is, however, a fallacy to suppose that it is necessary, or even desirable, that the aperture should remain circular or concentric when varied, and in this respect, the simple barrel or plunger throttle can be used to provide a variable choke tube just as effective in practice as the most elaborate device. The same principle is applied in the "mousetrap" carburettor, where the air passage is rectangular in section, and one of its sides is hinged, so as to be capable of swinging inwards at the intake end to concentrate the air flow over the jet, which is situated in the opposite and fixed side of the passage. Automatic control of the area of the choke tube is provided in mixing valves of the gravity or spring-loaded mushroom valve type, and "constant-suction" carburettors, such as the S.U. The latter principle, in theory at least, provides the nearest approach to the perfect carburettor, as the air flow is regulated by the engine to suit its own requirements, apart from changes in the throttle setting or the applied load; it does not depend upon a manually-operated control. But unfortunately, the introduction of automatic mechanical moving parts entails both friction and wear, which affect the accuracy of working; and in small carburettors such as are now under consideration, they may be of dubious advantage. I have used constant-suction carburettors on engines of 15 to 30 c.c. with complete success, and some of these have been described in past issues of THE MODEL ENGINEER.

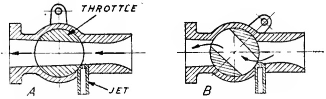


Fig. 6. Barrel-throttle carburettor with passage shaped to promote full-bore discharge efficiency

Submerged Jets

These also have been the subject of a good deal of experiment in the past, and have been dealt with in previous articles. The submerged jet offers a means of automatic control of jet output, independent of any mechanical device, and is by far the most popular method applied

*Continued from page 638, "M.E.," Vol. 95, December 26, 1946.

to full-sized modern carburettors. In most forms of submerged jets, the ruling principle is the partial or complete isolation of the jet from the effect of the suction in the main air passage; and by reason of the fact that the actual orifice is below the normal fuel level (as controlled by the float chamber) gravity plays some part in controlling its discharge.

Complete isolation of the jet, by locating it in a well open at the top to the atmosphere, and discharging fuel into the choke tube through a small aperture (usually called a "diffuser"), results in control by gravity only, so that the fuel

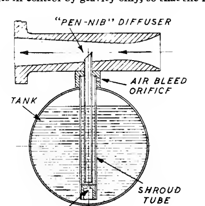


Fig. 7. Submerged jet suction carburettor

supply is exactly the same, whether the engine is running fast or slow. Thus with such a jet, too much fuel will be supplied at low speed, and too little at high speed. This is the principle used in the "compensating" jet of the Zenith carburettor, which is used to balance the output of the "main jet," a simple jet placed in the air stream in the usual way, so that it supplies too much fuel at high speed, and too little at low speed. When the two jets are correctly adjusted to suit a particular engine, their operation in conjunction produces a substantially constant mixture over a wide range of speed.

A more common form of submerged jet is that in which the entry of air into the jet well is limited by means of a fixed or variable orifice, usually termed an "air bleed." This causes the output of the jet to be affected to some extent by engine suction, in addition to gravity, and it thus becomes possible to obtain a correct mixture at various speeds without the use of a second jet.

The most effective form of submerged jet is one in which the jet is situated at the bottom of a well which functions, in effect, as a U-tube, one leg of which is taken into the choke tube, and serves to discharge the fuel into the air stream, while the other admits air from the controlled air bleed orifice. (For convenience in construction, these passages are often formed as concentric tubes.) Air which passes over the jet from the air bleed serves to emulsify the fuel discharged from the jet, which very much assists atomisation when it emerges into the main air stream; the discharge tube from the jet well is thus sometimes termed the "emulsion tube."

For consistent operation of a submerged jet, accurate control of the level of fuel over the orifice is at least highly desirable, therefore the use of float feed is definitely indicated. Attempts to apply the principles of submerged jet construction to a suction carburettor are usually fallacious and futile. On the face of it, there is no doubt that suction feed to the jet is quite incompatible with correct operation of this method of jet control. Of course, any simple suction carburettor becomes a submerged jet carburettor if its fuel tank is elevated above the level of the jet orifice, and as I have often pointed out, this principle can be applied to provide some measure of compensation, but it introduces the disadvantage of causing the carburettor to flood when the engine is stopped.

Some time ago I was faced with the problem of producing a carburettor to work on a stationary engine, taking its feed from a tank in the baseplate, so that float feed, or any kind of gravity feed, was impracticable. Throttle control had to be fitted, but it was necessary also to provide compensation for changes of load at full throttle. A simple suction carburettor with mechanical compensation by the throttle was first tried, and this satisfied the first requirement, but not the second. In other words, it enabled the engine speed to be regulated by the throttle, but if a heavy load were applied to the engine so as to reduce its speed considerably, the mixture would weaken, sometimes to the extent of "conking out." After some experiment, a

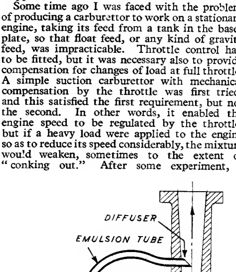


Fig. 8. The submerged jet applied to a carburettor in any position

submerged jet suction carburettor was evolved, which enabled the engine to stand a very considerable overload without losing its mixture compensation.

The elementary principle of this device is shown in Fig. 7, in a form suited to its application

to a small engine having the fuel tank located immediately under the carburettor. It will be seen that the jet orifice is located in the bottom of the fuel tank, and surmounted by a concentric U-tube, the outer member of which has an air bleed orifice at the top, well above the highest fuel level. The inner tube extends upwards into the choke tube, terminating in an angular cut-off which acts as a "pen-nib" diffuser—a common device, by the way, to accentuate the suction effect and produce turbulence at the point of discharge. No throttle is shown in this diagram, but if fitted, it would be placed in such a position as to have little or no effect on the jet, like the example shown in Fig. 1.

As will be seen from Fig. 7, the jet well will fill with fuel, up to the level of that in the tank, when the engine is standing, but as soon as suction is exerted at the diffuser orifice, fuel will be drawn up the inner tube and down the outer tube, acting as an initial or "priming" supply to assist in starting the engine. Thereafter, fuel will flow from the jet by gravity, assisted by suction communicated through the inner tube. At the highest speeds, air will be drawn down the outer tube from the air bleed orifice, serving to dilute the fuel drawn from the jet and mixing with it to form an air-fuel emulsion. Should the engine speed drop, so that suction on the diffuser tube is not maintained, the tendency is for the jet well to partially fill with fuel, blocking off the entry of air from the air bleed, and thereby enriching the mixture.

In the particular case for which the carburettor was designed, the choke tube was not so conveniently situated as in Fig. 7, but it was found quite practicable to lengthen the inner tube of the jet well, so as to form an emulsion tube to lead into the choke tube at any reasonable distance or level. The main air passage may also be disposed at any angle, including horizontal, and vertical updraught or downdraught, and various forms of diffusers may be used, without affecting the working of the device.

This type of carburettor has been found to work quite well on engines as small as 10 c.c., but in the smaller sizes of engines, some trouble may be caused by the rather excessive quantity of fuel contained in the jet well, in proportion to the size of the engine. If the air intake is strangled for starting, the whole of this fuel may be gulped into the engine, completely choking it, and necessitating a thorough draining and airing out before starting is possible. The inner and outer tubes must therefore be kept very small in diameter, and then it will be found that the skin friction in the small passages may impede air and fuel flow, necessitating a high suction to keep the carburettor working. A long emulsion tube is not desirable on a small engine, as it introduces a time lag in the flow through the tube, which makes control deceptive. When tried out on a 6-c.c. speed-boat engine, these factors rather marred an otherwise good performance, for the compensation was quite good, and the usual tendency to stall the engine when the boat was released appeared to be practically eliminated.

It will readily be understood that in the devices illustrated in Figs. 7 and 8, both the jet orifice and the air bleed orifices can be made variable without affecting the working principles.

There are many other possible ways of providing carburettor compensation, but I believe these to be the simplest, and users of small engines who wish to obtain flexibility of control, or to enable the engines to cope with wide variations of load, will find that they offer great possibilities if sufficient care and patience is exercised in applying them. This is the only alternative to remaining content with an engine which will only run properly flat out, or can only be regulated by fiddling with two or more adjustments. Crude methods of control were once tolerated by the users of full-sized engines, but when once the advantages of flexibility and smooth control were demonstrated, the old methods were soon rendered obsolete. I am convinced that small engines are also capable of equally effective control, and that in time this will be insisted upon by their users.

SIMPLE ALUMINIUM CASTING

(*Continued from page 62*)

it to move with apparent sluggishness. It is this meniscus which makes the casting of delicate shapes difficult unless one adopts the proper technique of the foundry and uses a "header" which will force the metal into the small recesses.

Allowances must be made for the meniscus at the tops of the moulds, which have been described, and the surplus metal eventually cut away, for the top of the casting is left with edges of $\frac{1}{8}$-in. radius or more.

The evils of the meniscus can be mitigated to some extent by gently tamping the surface of the molten metal with a piece of $\frac{3}{8}$-in. or $\frac{1}{2}$-in. rod. In so doing be careful not to distort the mould.

After pouring, allow castings to cool naturally. Refrain from chilling them in water in your eagerness to see the results of your efforts.

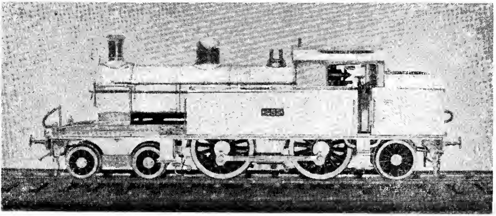
If the first trials are not altogether successful, do not be discouraged; with a little patience you will eventually succeed. There is quite a deal of satisfaction in making a small engine in its entirety from "A to Z" and the alternative to castings, that of machining from the solid, is often not feasible for lack of a suitable block of metal.

I have successfully made all the shapes described and a number of others also, for example, V-belt pulleys up to 4-in. diameter.

Another commending feature of the process is its inexpensiveness, for nothing more than is ordinarily available in the average modeller's workshop is needed.

AN IRISH GEM

T. J. Stone's 4-4-2 Gauge "O" Model



THE prototype is a 4-4-2 tank engine, built in 1909, for the old Dublin and South Eastern Railway. It was originally named "King George V," but is now "No. 455."

The model, which was built on a home-made lathe and with a minimum of tools ("workshop" being kitchen table and chair), is gauge "O" and is made of polished brass. It is as nearly to scale as is possible in a working model. It has a single cylinder, a water-tube boiler with water gauge, steam gauge, regulator, etc., and two almost scale size safety-valves, which work. It is fired by spirit, the spirit being contained in the bunker and one side tank. The other tank holds a displacement lubricator. The model has working brakes and leaf springs to every wheel; also, properly-made and scale-size couplings, vacuum brake pipes, etc. It has three lamps less than $\frac{3}{16}$ in. diameter and $\frac{3}{16}$ in. high, complete with door glasses. No bulbs small enough to fit the lamps could be obtained, so the three of them were made to light by means of bent glass rods leading to concealed flash lamp bulbs. The ends of the rods are ground to an angle of 45 degrees, so as to reflect the light out through the lamp glass. This model was mentioned in Mr. E. T. Westbury's recent article describing "Model Engineering in Ireland."

For the Bookshelf

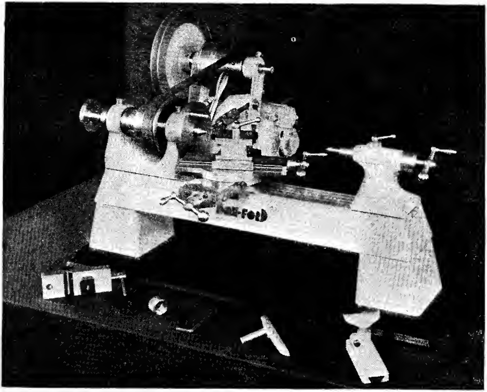
Railway Pictorial. (London: Greenlake Publications Ltd., 156, Camden High Street, N.W.1) Price 5s. 0d.

We have been favoured with a copy of this new quarterly periodical, with which is incorporated a section under the sub-title of "The Lineside Cameraman"; this section is reserved for the use of The Railway Photographic Society.

Essentially pictorial in character, the new journal is produced in excellent, even sumptuous style, and, at the outset, establishes a commendably high standard that is welcome at a time when large numbers of railway books, mostly of transitory value, are being published.

As might be expected, the illustrations are the principal feature; and, in view of this, we venture to offer one or two critical comments. We feel that the use of "cut-out" blocks should be avoided, if only because of the inherent risk of spoiling a fine photograph. For example, in the illustration of the L.M.S. engine No. 5668, *Madden*, at the foot of page 1, the left front running plate has been blocked out, resulting in an incongruous effect. This treatment of a photograph is, in itself, very seldom justified; and, unless the artist who undertakes it is thoroughly conversant with locomotive anatomy, weird and inaccurate effects are the usual result. Line-drawings, such as those of the five 4-6-4 Tank engines reproduced on pages 7, 8 and 9, are best left as plain mechanical drawings, and any attempt to add "pictorial" effect is not only quite inaccurate, but is apt to be very confusing to anyone who would wish to make use of the drawings. These remarks, of course, do not apply to purely pen-and-ink sketches such as the one at the bottom of page 57; here, the effect of light and shade is obviously necessary and therefore perfectly legitimate.

The photographic illustrations are generally excellent, and some—such as those on pages 2, 5, 11, 24, 35, 38, 39 and 40—are quite outstanding. The articles are varied, interesting and, each in its own way, informative. We look forward with interest and pleasure to future issues of this new journal; it seems destined to establish itself as a favourite worthy of the attention of all serious railway students and enthusiasts.



The Box-Ford 3-in. Centre Lathe

WE give herewith an illustration of a lathe which should appeal to readers who are requiring a well-designed machine tool of novel design. The main features are:—

Eight spindle speeds; simple belt adjustment; hollow spindle $\frac{1}{2}$-in. int. dia.; collet capacity up to $\frac{5}{16}$ in. dia.; unit countershaft drive; precision ground bed of vee and flat design; completely universal saddle; fully graduated; all feed screws are protected from swarf; two-way tool-holder; and a four-step cone pulley in place of three-step.

The saddle is of sturdy construction. All feed screws completely enclosed. The longitudinal slide is rotatable about the cross slide and is fully graduated. The tool-post is capable of complete rotation and includes facilities for easy tool adjustment and boring bar holding.

The head is of robust design with pulley giving four speeds by easy adjustment. Bearings are adequately lubricated and are adjustable for wear. Live collet-type centre.

Tailstock may be quickly clamped in any position by sturdy cam clamp. Easy feed on screw with centre knock out when fully adjusted back. No. 1 Morse taper in spindle.

Independent countershaft unit with two speeds from motor to countershaft and four speeds from countershaft to spindle. Simple belt tensioning device.

Specification

Height of centres, $3\frac{5}{16}$ in.; swings over saddle, dia., $3\frac{1}{2}$ in.; admits between centres, $9\frac{1}{4}$ in.; collet capacity up to $\frac{5}{16}$ in.; Size of tailstock centre, No. 1 Morse; spindle nose threaded $\frac{7}{8}$-in. B.S.F.; width of bed, $3\frac{1}{2}$ in.; length of useful slide, 17 in.; cross-feed traverse, $4\frac{1}{2}$ in.; feed screw graduations, 0-0.05 in. by 0.001 in.; motor, $\frac{1}{4}$ h.p., 1,425 r.p.m.; overall dimensions (including countershaft) 2 ft. 3 in. × 2 ft. × 1 ft. 4 in.; weight unpacked, 137 lb., with motor, 112 lb. without motor.

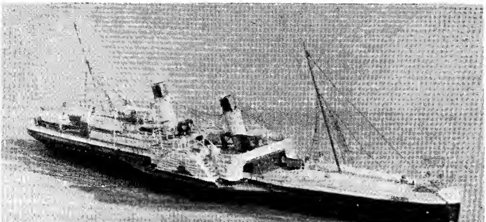
Speeds, with 1,425 r.p.m. motor: With 4 : 1 ratio motor to countershaft 170 r.p.m., 270 r.p.m., 460 r.p.m., 740 r.p.m.; with 2.4 : 1 ratio motor to countershaft, 280 r.p.m., 450 r.p.m., 760 r.p.m., 1,210 r.p.m.

Attachments

A range of suitable attachments are in process of development. Hand-rest attachment for use with hand tools may be speedily attached in place of compound slide.

The sole distributors of this lathe are Messrs. **J. & H. Smith Ltd., 6-8, The Headrow, Leeds, 1.**

"ROUEN" IN MINIATURE



THE two photographs reproduced herewith have been submitted by Mr. J. H. Ahern and present two aspects of a waterline model of the London, Brighton and South Coast Railway's cross-Channel paddle-steamer *Rouen*. This boat was taken over by Messrs. Little, who used her for operating a service between Barrow and Douglas (Isle of Man), and renamed her *Duchess of Buccleugh*.

The model was built by the late Ian Macnab, and was his first attempt at this kind of work. It is to the scale of 2 mm. to the foot; and, as the method of construction may be of use and interest to other novices, some details of it are given in the following notes.

The deck plans were transferred to a piece of deal and then it was cut to shape. The deck was cut away between forecastle head and a small portion at the stern which projected to the same height as the bulwarks. The latter was gouged out to the thickness of the bulwarks by the aid of tiny gouges of a Balsa wood cutting outfit, the small cutters fitting into a penholder. The paddle-box units consisted of three ply decks on which the planking was drawn, and bollards made from pins fitted in place. The deck houses on the sponsons were shaped and had a curved hump corresponding to the radius of the paddle-box. Two pieces of whitewood were shaped to the paddle-box profile then glued and pinned to the deck houses. After this, paddle-box units were glued to the sponson decks. These latter had been cut to allow a margin to fit into a recess on each side of the hull. I knew it would be a tricky job cutting louvres in wood, so made Bristol board profiles of the paddle boxes and cut them out on this material afterwards gluing them in place.

There were some nasty knots on the hull, so to hide these imperfections, the whole of it was covered with gummed parcel tape, which made a fair representation of ship plating. A deep saw-cut was made in the bows into which a piece of card was glued to form a stem, the top being extended to form tiny bulwarks each side of the bows. A rubbing was taken of the deck from forecastle to stern, and was transferred to Bristol board so the deck planking could be drawn in ink. After this was drawn, the deck cut-out was glued on the hull and then bulwarks of card were fitted. At this stage a piece of pine was shaped to suit the saloon and deck cabins of such a width that a space was left to form an alley-way between each paddle-box. Fixing the rail stanchions on the upper deck presented a problem, so a dummy deck of thick strawboard the full width between the paddle boxes was next fitted. The after end was shaped to the saloon, while the thickness of the sides was hidden by the storm canvas shields of drawing paper. The saloon had windows and panels outlined in ink, the whole afterwards being varnished. After the saloon and board deck were fitted, a final upper deck profile embracing the full width and sponson deck houses were drawn out. On this, hatchways, funnels, skylights, wheel-house, were all marked, the planking being drawn in. This deck was of Bristol board, and after cutting out, was glued in place.

Ports were indicated by rows of embossed circles done by a $\frac{1}{16}$-in. diameter steel punch. The hull was painted with Robbialac black enamel, the red waterline being drawn by drawing pen, and the space painted in red.

Bulwarks and turtle deck were painted white. The top hand-rail of the bulwarks was formed by gluing long thin slivers of wooden tapers on top of the card. The wheel-house was a piece of teak with doors and panels drawn in ink and the windows are cavities filled with several

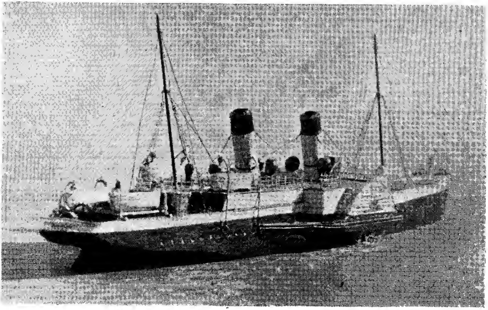
applications of "Durofix." After varnishing, the wheel-house has a projecting roof of white card.

The funnels were ex-cartridge fuse cases, recovered from some railway signalling equipment! The tubes were covered with parcel strip, a small circle also being put inside at one end, the projecting piece forming the tops of the inner casings. By the top band, 1/32-in. diameter holes were drilled where the guy wires came and 36-gauge D.S.C. wire was threaded and formed into loops for attaching the lengths of wire. Black bands were drawn on paper, afterwards being wrapped and glued in place on the funnels. Prior to this the funnels had been painted white and the lower ends cut to form the angle of rake. Pieces of dowel were made a push fit inside the funnels and then cut off at the angle of rake and then they were glued and pinned to the deck. When set, these stumps were coated with glue and the funnels slipped down over them.

The position of the rails and stanchions was marked and the holes for the latter partly made by a needle in a pin chuck. Lill pins formed the stanchions their right height being maintained by supporting them in a slot cut in a wood block, whose thickness equalled the height of the stanchions above deck.

The hand-railing was of 36-gauge D.S.C. wire. A start was made by the paddle-box and a double turn made round each pin to the opposite box. For the two intermediate rows a block of wood was cut of a thickness equal to the higher rail. The wire was wrapped round the pins as before the height being checked between them by the block. For the lower rails the block was again cut to suit. The silk covering of the wire enabled it to be glued to the pins, though where necessary the covering was bared and the wire soldered. The guy wires of the funnels was the same wire twisted and soldered to the funnel loops, and anchored by pins to the deck. Hatchways, skylights, and lifeboats were pieces of satin walnut cut and filed to shape. The former were inked and varnished. The lifeboats were painted white, the rope hand-holds and vessel's name being done in ink. Davits were brass wire or pins, having the blocks soldered to them. Blocks were pieces of 16-gauge bare copper wire with turns of 36 s.w.g. between them. Two pieces of 16 s.w.g. were placed each in a hole about $\frac{1}{8}$ in. apart on a wood block, and then four turns of thin wire taken between each piece of 16 s.w.g. Where the 26 s.w.g. touched the thick upright it was soldered, a long length of the thin wire being left from each block. The finished, unit was lifted from the jig and the 16 s.w.g. cut and filed, then the free wire from one block was wrapped round a davit and soldered. The boats and chocks were glued in place and the lower free wire from its block was twisted round the stem of each boat and anchored by a spot of glue.

Knitting needles were used as masts, and the rigging formed by 36-gauge D.S.C. The main shrouds were fixed to pins on a block of wood and this time the wires were bared and tinned. Cross wires were pinned in place and these soldered to the shrouds after which the unit was trimmed up and one had a complete set of steps. One end was soldered to the mast and the bottom free ends soldered to pins in the hull. Making this rigging was about the trickiest job of the model. Ventilators were shaped from wood, but they are not very satisfactory substitutes, and it is difficult to know an alternative method of producing such items in a small scale.



A clock wheel, suitably painted, made a stern steering wheel, the binnacle and telegraph being formed of brass rod and tube, while round-head screws and solder after doctoring with a file make passable winches. The anchor was made from 16 s.w.g. square busbar, the ends were flattened and the flukes filed out, and the main stem was a pin bent and soldered to the busbar. When everything was in place the decks were varnished, the masts painted black and the paint touched up. Ports were further indicated by a spot of sky blue in each recess, and afterwards a tiny spot of white was put in some to indicate reflection.

A section of paddle wheel, such as would be seen between water and sponson deck, was made from tinplate, long pins projecting from the two visible floats on one side. The paddle units were painted red lead, and when dry their pins pressed into the hull kept them in place.

Finally, a coat of arms was painted on a piece of Bristol board and after the shields were cut out they were glued on the paddle boxes, and the boat was complete.

Letters

Single-phase Transformer Design

DEAR SIR,—In his article headed as above, Mr. Watts makes a valiant attempt to cover a complicated subject in a short space.

The opening paragraph infers that fundamentals of design are simple and easily comprehended by the reader, but, in his subsequent discourse on transformer theory, limitation of space compels Mr. Watts to state, rather than explain.

One may assume from this that the article is intended for readers with advanced knowledge of electrical theory, who are well aware that there is practically no limit to the number of copper-iron combinations satisfying the fundamental transformer equation, but who desire to know how to arrange the cards so that the calculations involved are directed to either the best copper-iron combination or such combination which gives a predetermined performance.

I must confess to a feeling of disappointment with the method suggested, and particularly with the example of design, as I feel that Mr. Watts has not done justice to either his choice of a title or his obvious grasp of the subject.

There are three British Standards Institution Specifications covering performance of small transformers coming within the range of the article, Nos. 794, 831 and 832, and it would have been no more difficult to lead the reader to accepted standards of performance.

The copper density of 1,500 is too high for a temperature rise not exceeding 50° C., but if this is reduced to 1,000, the efficiency will be improved, and the temperature rise kept within the limit.

This will entail alterations to the window dimensions, but the total weight need not be increased; it can, in fact, be lightened for a higher efficiency.

"Two layers of empire tape between windings" is just not good enough; all major insulation should be not less than 40 mils. for the 2,000-volt test to earth.

As a matter of interest, I have worked out five examples from Mr. Watts's directives (Table 1), and for comparison give the same transformers designed to B.S.I. 794 (L.V. Transformers up to 1.0 kVA) (Table 2).

It will be seen that all comply with the specification for temperature rise after four hours at full load because of the higher efficiency. The increased copper has been offset by a reduction in iron, and four out of the five are lighter in total weight. The increase in K, however, indicates a percentage difference in cost, depending on current prices for stampings and copper.

Yours faithfully,

Bromsgrove. A. BARHAM.

Mr. Watts, to whom the above letter was sent, has replied as follows :—

DEAR SIR,—I have read with interest Mr. Barham's remarks on the subject of Single-Phase Transformer Design. Mr. Barham is hardly correct in assuming that my article was intended

TABLE 1

V.A. output	60	120	250	250	750
Iron losses, per cent.	6.93	6.67	5.18	2.06	1.84
Copper losses, per cent.	12.3	11.1	8.83	8.08	8.1
Efficiency, per cent.	80.75	82.2	85.8	89.9	90.4
	Lohys	Lohys	Lohys	Stalloy	Stalloy
Weight of iron, lb.	3.42	6.56	10.6	18.5	24.7
Weight of copper, lb.	1.57	3.0	4.4	9.3	10.34
Weight wound core, lb.	4.99	9.56	15.0	27.8	35.04
Cooling surface, sq. in.	59.34	93.1	124.8	185.0	227.0
Temperature rise, C°	48.5°	57°	70°	68.5°	82°
Value of K.	0.458	0.457	0.415	0.502	0.430

Value of B . . . . 60,000 Copper space factor 0.38

Current density . . . . 1,500 Core section $A = \sqrt{\dfrac{\text{VA output}}{5.6}}$

TABLE 2

V.A. output	60	120	250	500	750
Iron losses, per cent.	6.61	5.54	4.77	1.98	1.78
Copper losses, per cent.	7.13	6.33	4.8	3.82	3.55
Efficiency, per cent.	86.3	88.15	90.37	94.22	94.65
	Lohys	Lohys	Lohys	Stalloy	Stalloy
Weight of iron, lb.	3.25	5.46	9.80	15.42	20.8
Weight of copper, lb.	1.936	2.76	5.14	9.64	12.56
Weight wound core, lb.	5.186	8.22	14.94	25.06	33.36
Cooling surface, sq. in.	64	90	128	170	214
Temperature rise, C°	32°	39.5°	47°	42.4°	47°
Value of K.	0.595	0.508	0.526	0.625	0.600

Value of B. . . . . . . 61,000/64,500 Copper space factor 0.34/0.36

Current density . . . . . . 1,000 Core section . . $A = \sqrt{\dfrac{\text{VA output}}{7.53 \text{ to } 7.69}}$

to advise readers, with advanced knowledge of electrical theory, how to design transformers for maximum efficiency and exact performance. It was considered that such a programme would be far too ambitious for the space available. The intention was to explain how to make small workable transformers in such a way that the description and methods could be followed by any model engineer, and to do this the elements of design were reduced to their simplest forms.

Maximum efficiency with fixed limits of temperature rise can, of course, best be obtained by individual design using the ratio of copper to iron which is found to be most advantageous for the transformer in question. Treatment of the subject on these lines would, however, have detracted from the simplicity of the article and was not considered necessary, as a few per cent. increase of efficiency is rarely of great importance to the class of users for whom the article was intended, i.e. readers requiring a small transformer which is generally operated intermittently.

This class of reader could hardly be greatly interested in, or derive much assistance from, the British Standards Specifications referred to; and would in most cases have no facilities for carrying out a 2,000-volt test of the insulation. Two layers of empire tape between primary and secondary windings should be quite sufficient to withstand the working voltage; but if such high voltage tests are to be applied, then, of course, more efficient insulation is advisable, and for commercial production much more detailed design is an advantage.

I would mention that several small transformers have been designed and constructed on the lines suggested in the article, and have given good service. In conclusion, I would like to thank Mr. Barham for the detailed comparison of transformers given in Tables 1 and 2, which I have perused with much interest.

Yours faithfully,

Southampton. J. L. WATTS.

"Finish" on Small Locomotives

DEAR SIR,—The article on THE MODEL ENGINEER Exhibition by one of the judges is most interesting and certainly points out the many pitfalls to be avoided, if one's locomotive is to possess that certain "realism" which is at once apparent in any good model.

It has long been my contention that, in order to produce this result, one must combine with the purely mechanical skill required to build the locomotive, the same "aesthetic sense" which the artist uses in producing a painting or drawing. Just as the artist has a certain freedom in the "style" he adopts for his picture, so the small locomotive builder is free in his choice of style for the finish of his locomotive—at any rate, so far as "free-lance" designs are concerned.

If similarity to full-size practice be taken as a criterion, then, from the many thousands of locomotives, past and present, throughout the world, one can find infinite variety in colour schemes, proportion of details and styles of finish, etc.

I notice that exception is taken to the high polishing of wheel rims, and, whilst obviously this is not desirable on the treads, numerous examples have appeared in full-size practice of the outer face of the tyre being so polished—during the days of my apprenticeship at the Doncaster Locomotive Works it fell to my lot to "do the needful" with emery cloth and a disc grinder to the wheels of the then new *Cock o' the North*, No. 2001—a task I shall not readily forget!

As for nickel and chromium plating, the *Railway Gazette* of May 10th, 1935, contains a description and beautiful photograph of L.M.S. Locomotive No. 5552, *Silver Jubilee*, giving details of the method of plating used on this engine; and very nice this splendid machine looked "ex-works."

If the small locomotive builder will take a few pains over the proportions of the details on his engine and on the other items set out in your excellent article, he will be amply rewarded—"A thing of beauty is a joy for ever."

Yours faithfully,

Louth. JOHN R. BURDETT.

Calling Newbury District

DEAR SIR,—I would be glad if you would publish a request that anyone interested in this area in forming a model engineering society, to communicate with me at 15, Bartlemy Road, Newbury, Berks.

Yours faithfully,

R. THURLEY.